

6

# ANALYSIS OF RUNWAY OCCUPANCY TIME DATA COLLECTED AT LOS ANGELES, SAN FRANCISCO, ATLANTA, AND DALLAS-FORT WORTH AIRPORTS

AD-A161 137

WILLIAM E. WEISS

The MITRE Corporation  
McLean, Virginia 22102



SEPTEMBER 1985

Document is available to the U.S. public through  
the National Technical Information Service  
Springfield, Virginia 22161

DTIC  
ELECTE  
NOV 14 1985  
S E D

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION  
OFFICE OF SYSTEM STUDIES AND COOPERATIVE PROGRAMS  
Washington, D.C. 20591

85 11 12 076

DTIC FILE COPY

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

|  |   |  |  |
|--|---|--|--|
| 1. Report No.<br>FAA-DL5-85-3  | 2. Government Accession No.<br>10-4161137   | 3. Recipient's Catalog No.   |  |
| 4. Title and Subtitle<br>Analysis of Runway Occupancy Time Data Collected At Los Angeles, San Francisco, Atlanta, and Dallas-Fort Worth Airports   |   | 5. Report Date<br>September 1985   | 6. Performing Organization Code                |
|  |   | 8. Performing Organization Report No.<br>MTR-85W179  | 10. Work Unit No. (TRAIS)                      |
| 7. Author(s)<br>William E. Weiss   | 9. Performing Organization Name and Address<br>The MITRE Corporation<br>1820 Dolley Madison Blvd.<br>McLean, Virginia 22102 |  | 11. Contract or Grant No.<br>DTFAC1-84-C-00001 |
| 12. Sponsoring Agency Name and Address<br>Department of Transportation<br>Federal Aviation Administration<br>Office of Systems Studies and Cooperative Programs<br>Washington, D.C. 20591  |   | 13. Type of Report and Period Covered  |  |
|  |   | 14. Sponsoring Agency Code<br>ADL-5  |  |
| 15. Supplementary Notes  |   |  |  |
| 16. Abstract<br><p>Due to recent increases in delays to aircraft at major airports, several concepts for increasing airport capacity have gained impetus. One of these concepts is the reduction of longitudinal separation between certain classes of aircraft in Instrument Meteorological Conditions on final approach.</p> <p>A demonstration program for this concept has been developed by Air Traffic Service of the Federal Aviation Administration. Prior to the start of that program, it was necessary to ascertain that runway occupancy times were low enough (below 50 seconds) to allow the decreased separations. To that end, runway occupancy time data were collected at Los Angeles, San Francisco, Atlanta, and Dallas-Fort Worth airports. This document details the analysis of that data. The actual data collected is included in Appendix A.</p> |   |  |  |
| 17. Key Words<br>Runway Occupancy Time, Aircraft Separation, Los Angeles, San Francisco, Atlanta, Dallas-Fort Worth  |   | 18. Distribution Statement<br>Available to the Public through the National Technical Information Service, Springfield, Virginia 22161. |  |
| 19. Security Classif. (of this report)<br>Unclassified   | 20. Security Classif. (of this page)<br>Unclassified  | 21. No. of Pages   | 22. Price                                      |

## EXECUTIVE SUMMARY

Due to recent increases in delays to aircraft at major airports, several concepts for increasing airport capacity have gained impetus. One of these concepts is the reduction of longitudinal separation between certain classes of aircraft in Instrument Meteorological Conditions on final approach.

A study performed by The MITRE Corporation in 1979 indicated that, if the wake vortex problem could be resolved, a reduction in longitudinal separation to 2.5 nautical miles (nmi) would be possible, with no increase in the rate of go-arounds, if the average Runway Occupancy Time (ROT) were below 50 seconds.

In 1982, the Industry Task Force on Capacity Improvement and Delay Reduction agreed that 2.5 nmi could be demonstrated at selected sites under controlled conditions. A demonstration program for this concept was subsequently developed by Air Traffic Service of the Federal Aviation Administration.

Los Angeles, San Francisco, Atlanta, and Dallas-Fort Worth were selected as possible sites for the demonstration program. Prior to the start of that program, it was necessary to ascertain that runway occupancy times were low enough (below 50 seconds) to allow the decreased separations. ROT data were then collected at those airports. This document details the analysis of that data. The actual data collected is included in Appendix A.

The overall average ROTs (for Small and Large aircraft only) at Atlanta and Dallas-Fort Worth are well below 50 seconds. The average ROT at Los Angeles is near 50 seconds, while at San Francisco it is above 57 seconds. (The data are summarized in Tables 1 and 2.) Atlanta, Dallas-Fort Worth, and Los Angeles are all suitable sites for the demonstration.

|                    |                                     |
|--------------------|-------------------------------------|
| Accession For      |                                     |
| NTIS GRA&I         | <input checked="" type="checkbox"/> |
| DTIC TAB           | <input type="checkbox"/>            |
| Unannounced        | <input type="checkbox"/>            |
| Justification      |                                     |
| By                 |                                     |
| Distribution/      |                                     |
| Availability Codes |                                     |
| Dist               | Avail and/or<br>Special             |
| A-1                |                                     |

111



TABLE 1  
SUMMARY OF LOS ANGELES AND SAN FRANCISCO  
RUNWAY OCCUPANCY TIME DATA\*

LOS ANGELES:

| <u>RUNWAY</u> | <u>MEAN<br/>(seconds)</u> | <u>STD. DEV.<br/>(seconds)</u> | <u>NUMBER OF<br/>OBSERVATIONS</u> |
|---------------|---------------------------|--------------------------------|-----------------------------------|
| 24L           | 48.7                      | 7.5                            | 68                                |
| 24R           | 50.3                      | 9.4                            | 70                                |
| 25L           | 51.8                      | 10.8                           | 102                               |
| 25R           | 52.0                      | 7.7                            | 43                                |
| <hr/>         |                           |                                |                                   |
| Overall       | 50.7                      | 9.4                            | 283                               |

SAN FRANCISCO:

|         |      |      |     |
|---------|------|------|-----|
| 1L      | 30.0 | 0.0  | 1   |
| 1R      | 45.0 | 11.7 | 9   |
| 28L     | 59.6 | 15.2 | 120 |
| 28R     | 56.2 | 13.3 | 177 |
| <hr/>   |      |      |     |
| Overall | 57.1 | 14.3 | 307 |

\* Small and Large aircraft only.

TABLE 2  
SUMMARY OF DALLAS-FORT WORTH AND ATLANTA  
RUNWAY OCCUPANCY TIME DATA\*

DALLAS-FORT WORTH:

| <u>RUNWAY</u> | <u>MEAN<br/>(seconds)</u> | <u>STD. DEV.<br/>(seconds)</u> | <u>NUMBER OF<br/>OBSERVATIONS</u> |
|---------------|---------------------------|--------------------------------|-----------------------------------|
| 17L           | 45.1                      | 8.4                            | 97                                |
| 18R           | 46.4                      | 7.1                            | 55                                |
| <hr/>         |                           |                                |                                   |
| Overall       | 45.6                      | 8.0                            | 152                               |

ATLANTA:

|         |      |     |     |
|---------|------|-----|-----|
| 8L      | 42.4 | 5.0 | 69  |
| 9R      | 40.4 | 5.8 | 106 |
| 27L     | 42.8 | 5.7 | 63  |
| <hr/>   |      |     |     |
| Overall | 41.6 | 5.6 | 238 |

\* Small and Large aircraft only.

## TABLE OF CONTENTS

|   | <u>Page</u> |
|---|-------------|
| 1. INTRODUCTION                                   | 1-1         |
| 1.1 Purpose and Scope                             | 1-2         |
| 2. THE DATA COLLECTION EFFORTS                    | 2-1         |
| 2.1 Los Angeles and San Francisco Data Collection | 2-1         |
| 2.2 Dallas-Fort Worth and Atlanta Data Collection | 2-1         |
| 3. ANALYSIS OF DATA AND CONCLUSIONS               | 3-1         |
| APPENDIX A: RUNWAY OCCUPANCY TIME                 | A-1         |
| APPENDIX B: AUTOMATED DATA COLLECTION             | B-1         |
| APPENDIX C: LIST OF ACRONYMS                      | C-1         |
| APPENDIX D: REFERENCES                            | D-1         |

## LIST OF ILLUSTRATIONS

|   | <u>Page</u> |
|---|-------------|
| TABLE 3-1: SUMMARY OF LOS ANGELES RUNWAY OCCUPANCY TIME DATA            | 3-2         |
| TABLE 3-2: SUMMARY OF SAN FRANCISCO RUNWAY OCCUPANCY TIME DATA          | 3-2         |
| TABLE 3-3: SUMMARY OF DALLAS-FORT WORTH RUNWAY OCCUPANCY TIME DATA      | 3-3         |
| TABLE 3-4: SUMMARY OF ATLANTA RUNWAY OCCUPANCY TIME DATA                | 3-3         |
| TABLE A-1: AIRLINE CODES  | A-2         |
| TABLE A-2: AIRCRAFT TYPE CODES  | A-3         |
| TABLE A-3: LOS ANGELES RUNWAY OCCUPANCY TIME DATA                       | A-4         |
| TABLE A-4: SAN FRANCISCO RUNWAY OCCUPANCY TIME DATA                     | A-11        |
| TABLE A-5: DALLAS-FORT WORTH RUNWAY OCCUPANCY TIME DATA                 | A-19        |
| TABLE A-6: ATLANTA RUNWAY OCCUPANCY TIME DATA                           | A-23        |
| <br>  |             |
| FIGURE 2-1: LOS ANGELES INTERNATIONAL AIRPORT                           | 2-2         |
| FIGURE 2-2: SAN FRANCISCO INTERNATIONAL AIRPORT                         | 2-3         |
| FIGURE 2-3: DATA COLLECTION FORM FOR ARRIVAL RUNWAY OCCUPANCY TIME DATA | 2-4         |
| FIGURE 2-4: DALLAS-FORT WORTH INTERNATIONAL AIRPORT                     | 2-6         |
| FIGURE 2-5: HARTSFIELD ATLANTA INTERNATIONAL AIRPORT                    | 2-7         |



## 1. INTRODUCTION

Due to recent increases in delays to aircraft at major airports, several concepts for increasing airport capacity have gained impetus (Reference 1). One of these concepts is the reduction of longitudinal separation between certain classes of aircraft in Instrument Meteorological Conditions (IMC) on final approach.

A rigorous study of the requirements for reducing the minimum longitudinal separation to 2.5 nautical miles (nmi) and 2.0 nmi was performed by The MITRE Corporation in 1979 (Reference 2). It concluded that, if the wake vortex problem could be resolved, a reduction to 2.5 nmi would be possible if the average Runway Occupancy Times (ROT) were below 50 seconds.

In 1982 the Industry Task Force on Capacity Improvement and Delay Reduction reached agreement among its members that 2.5 nmi separations could be demonstrated at selected sites under controlled conditions. One of those conditions was that the average ROT be determined at each potential site prior to the start of the demonstration program and that the average must be less than 50 seconds.

In 1984, MITRE performed a study of ROTs at New York La Guardia (LGA), Boston (BOS), and Newark (EWR), airports (Reference 3). The following average ROTs (in seconds) were determined in that study:

| Aircraft Type | LGA  | BOS  | EWR  |
|---------------|------|------|------|
| Small         | 43.5 | 48.7 | 40.1 |
| Large         | 46.0 | 52.1 | 42.2 |
| Heavy         | 50.5 | 56.7 | 45.6 |

As a result of that study and continued support of the concept by the Industry Task Force, a demonstration program was developed by the Federal Aviation Administration's (FAAs) Terminal Procedures Branch of Air Traffic Service and The MITRE Corporation. This program was designed to demonstrate the feasibility of using 2.5 nmi separations between certain pairs of aircraft on final approach.

Prior to the start of the program, ROT data were collected at Los Angeles, San Francisco, Atlanta, and Dallas-Fort Worth airports, sites under consideration for the demonstration program. The results of the data collection efforts are detailed in this report.

### 1.1 Purpose and Scope

The purpose of the data-collection effort and subsequent analysis was to obtain ROT information at the four airports mentioned above operating under the current rules. The scope of the effort was limited to runway occupancy time since it is a critical element of the reduced longitudinal separation demonstration program.

## 2. THE DATA COLLECTION EFFORTS

### 2.1 Los Angeles and San Francisco Data Collection

The Los Angeles and San Francisco data were collected using a portable computer. The computer's built-in clock allowed a single observer to collect data on up to four runways simultaneously. The data were stored on cassette tapes and later transferred to a mainframe computer for statistical analysis.

The data were collected at Los Angeles on January 8, 1985 from 7:17 am until 2:00 pm and on January 9, 1985 from 7:39 am until 10:27 am under the following conditions:

|                     |  |
|---------------------|--|
| Weather Conditions: | Visual Meteorological Conditions (VMC) |
| Runway Conditions:  | Dry                                    |
| Ceiling:            | Unlimited                              |
| Visibility:         | 15 to 35 nmi                           |
| Wind Direction:     | 70 to 220 degrees                      |
| Wind Speed:         | 6 to 15 miles per hour (mph)           |
| Temperature:        | 62 to 75 degrees Fahrenheit            |

Figure 2-1 illustrates the runway/taxiway layout at Los Angeles.

The data were collected at San Francisco on January 9, 1985 from 2:29 pm until 5:07 pm, on January 10, 1985 from 2:44 pm until 7:50 pm, and on January 11, 1985 from 10:00 am until 1:57 pm under the following conditions:

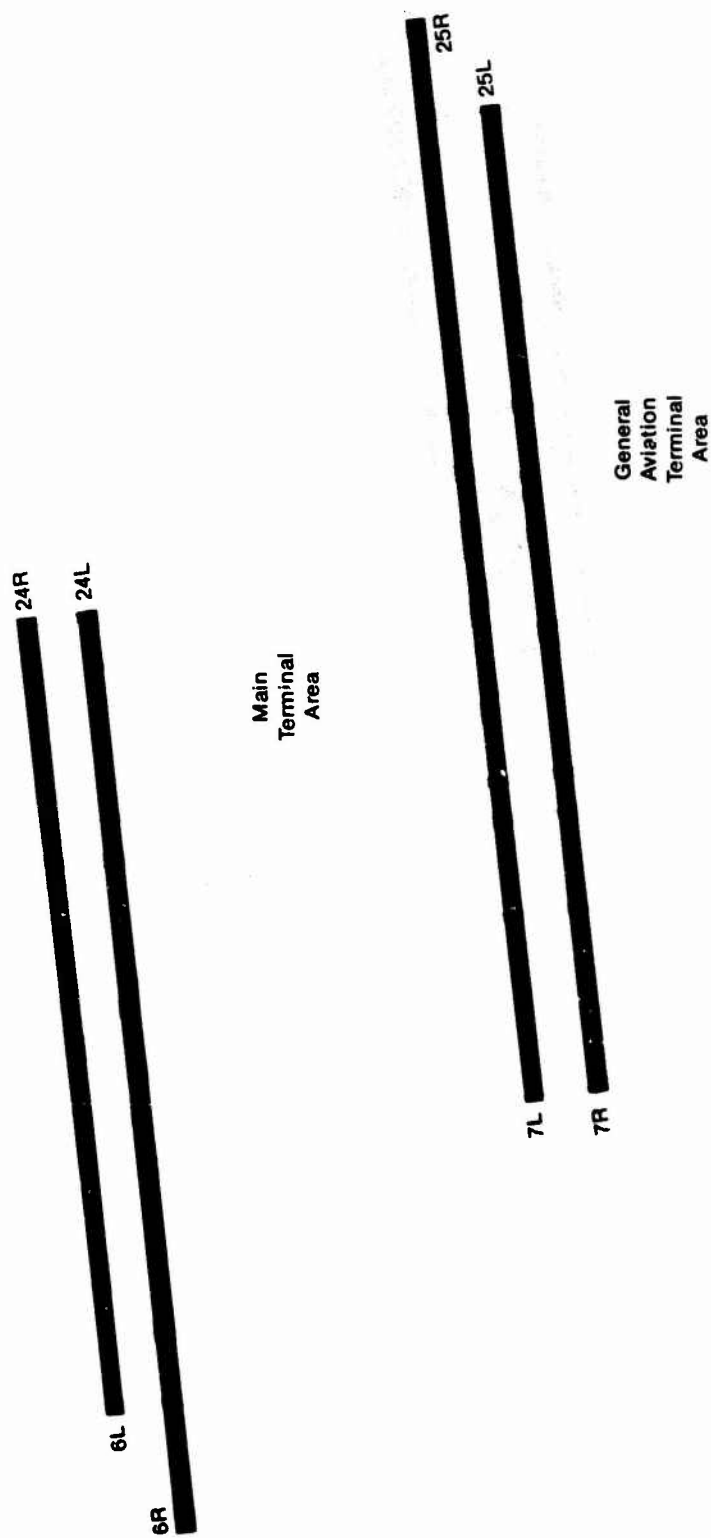
|                     |  |
|---------------------|--|
| Weather Conditions: | VMC (except for fog on Jan 11)                     |
| Runway Conditions:  | Dry  |
| Ceiling:            | 3000 feet to unlimited (except for fog conditions) |
| Visibility:         | 1 (in fog) to 10 nmi                               |
| Wind Direction:     | 70 to 180 degrees                                  |
| Wind Speed:         | Calm to 7 mph                                      |
| Temperature:        | 65 to 75 degrees Fahrenheit                        |

Figure 2-2 illustrates the runway/taxiway layout at San Francisco.

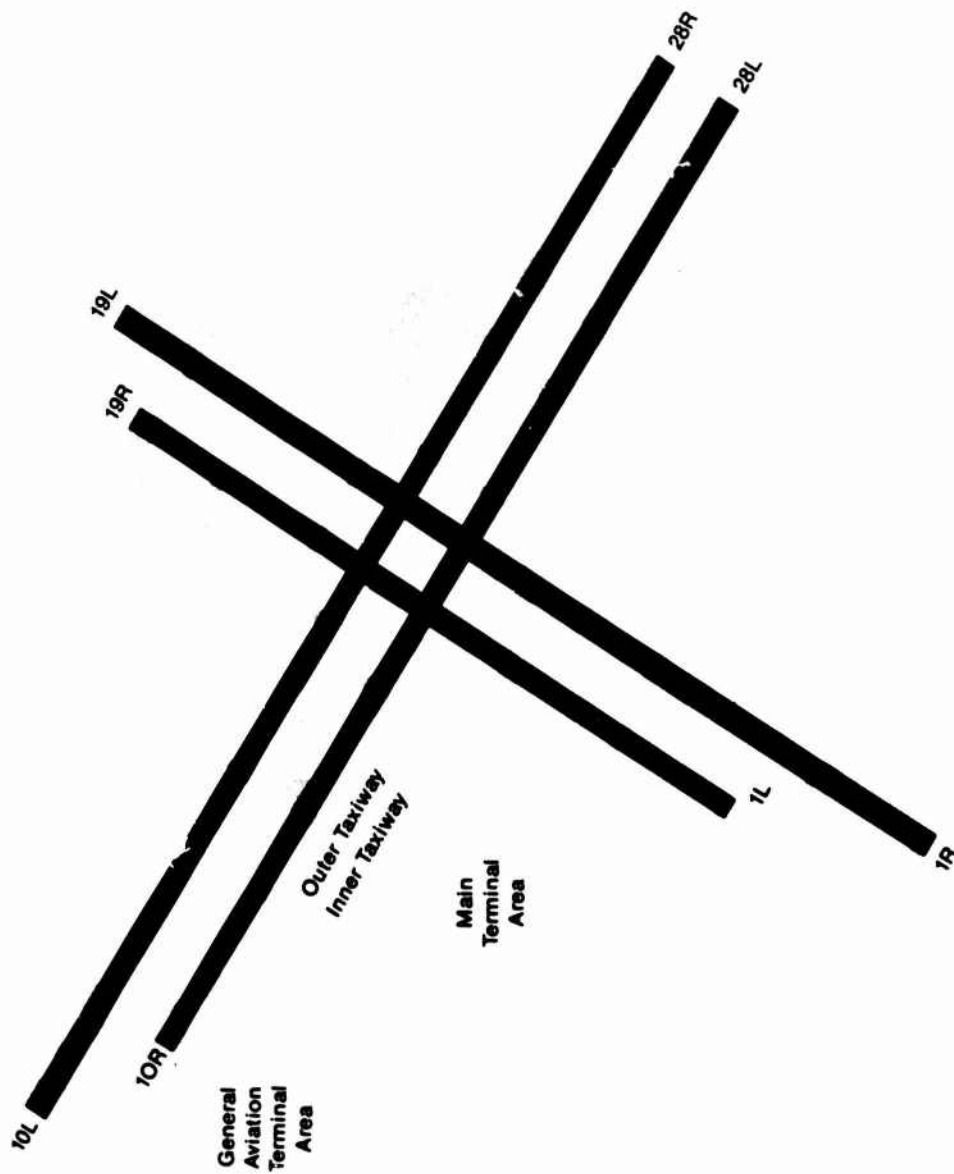
Data were collected for Small and Large aircraft types and can be found in Appendix A.

### 2.2 Dallas-Fort Worth and Atlanta Data Collection

Air traffic personnel from Dallas-Fort Worth and Atlanta collected the data using a MITRE-developed form shown in Figure 2-3.



**FIGURE 2-1**  
**LOS ANGELES INTERNATIONAL AIRPORT**



**FIGURE 2-2**  
**SAN FRANCISCO INTERNATIONAL AIRPORT**

**RUNWAY OCCUPANCY TIME DATA (ARRIVALS)**

ZULU Time   :  :    
HH:MM:SS

**MAIN ARRIVAL RUNWAY**\_\_\_\_\_

**Airport\_\_\_\_\_**

CEILING \_\_\_\_\_  
VISIBILITY \_\_\_\_\_  
WIND DIRECTION \_\_\_\_\_  
WIND SPEED \_\_\_\_\_

-Check (✓) if runway used for crossing by taxiing or departure from crossrunway after this arrival.

[illegible]

**FIGURE 2-3  
DATA COLLECTION FORM FOR  
ARRIVAL RUNWAY OCCUPANCY TIME DATA**

The data were collected at Dallas-Fort Worth on April 19, 1985 from 2:33 pm until 8:08 pm under the following conditions:

|                     |  |
|---------------------|--|
| Weather Conditions: | VMC  |
| Runway Conditions:  | Dry  |
| Ceiling:            | Varied from 2200 feet/overcast to 3200 feet/broken |
| Visibility:         | Varied from 8 to 12 nmi                            |
| Wind Direction:     | 160 to 170 degrees                                 |
| Wind Speed:         | 11 to 18 mph, with gusts up to 24 mph              |
| Temperature:        | 70 to 74 degrees Fahrenheit.                       |

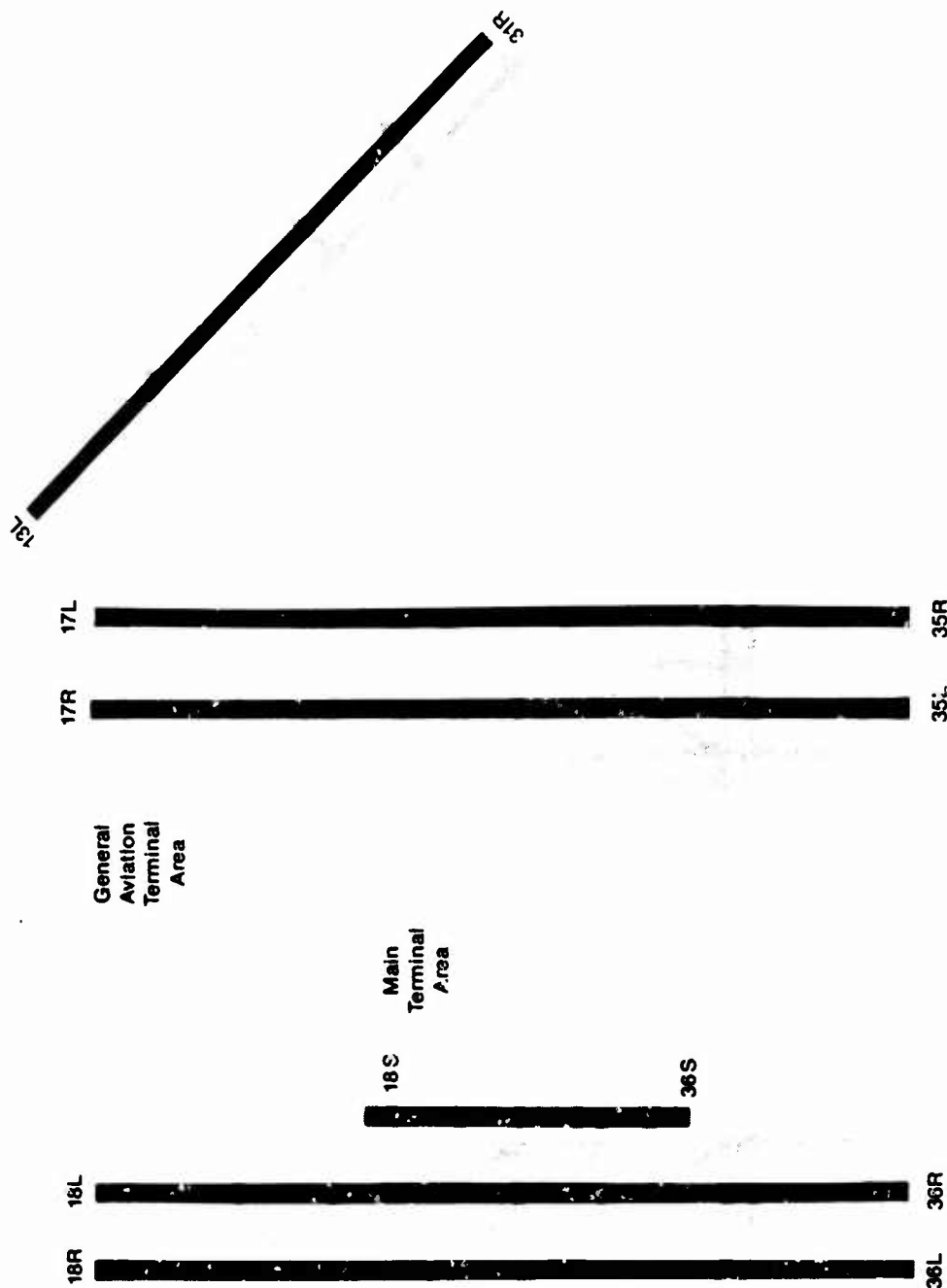
Figure 2-4 illustrates the runway/taxiway layout at Dallas-Fort Worth.

The data were collected at Atlanta on April 22, 1985 from 1:50 pm until 8:48 pm and on April 23, 1985 from 1:24 pm until 6:06 pm under the following conditions:

|                     |   |
|---------------------|---|
| Weather Conditions: | VMC                                     |
| Runway Conditions:  | Dry                                     |
| Ceiling:            | Varied from 25,000 feet/broken to clear |
| Visibility:         | 10 to 15 nmi                            |
| Wind Direction:     | 110 to 210 degrees                      |
| Wind Speed:         | 5 to 18 mph                             |
| Temperature:        | unknown                                 |

Figure 2-5 illustrates the runway/taxiway layout at Atlanta.

Data were collected for all aircraft types and can be found in Appendix A.



**FIGURE 2-4**  
**DALLAS-FORT WORTH INTERNATIONAL AIRPORT**



General  
Aviation  
Terminal  
Area

8L 26R  
8R 26L

Main  
Terminal  
Area

9L 27R  
9R 27L

FIGURE 2-5  
HARTSFIELD ATLANTA INTERNATIONAL AIRPORT

### 3. ANALYSIS OF DATA AND CONCLUSIONS

Descriptive statistics were produced for Small and Large aircraft using a computer-based statistical package. They are summarized in Tables 3-1 through 3-4.

The overall average ROT at Los Angeles was close to 50 seconds under predominantly tailwind landing conditions. It is likely that the average ROTs would drop below 50 seconds in the absence of this tailwind; therefore, Los Angeles should be a suitable site for the demonstration.

The overall average ROT at San Francisco was over 57 seconds. This high average ROT was due to the following two procedures in effect on runways 28L and 28R:

1. General Aviation aircraft (including business jets) were allowed to use the entire length of the runways, when landing, to reach the fixed base operator at the far end.
2. United Airlines, Wings West, and West Air consistently used exits beyond high-speed exits E, J, and T to reach their gates.

These procedures reduced taxi time and helped relieve congestion on outer taxiway B. They were used in all but the heaviest traffic conditions.

Due to the high ROTs resulting from these procedures, San Francisco would not be a suitable site for the demonstration.

ROTs at Dallas-Fort Worth and Atlanta averaged well under 50 seconds (under the conditions described). These sites should be suitable for the demonstration.

TABLE 3-1  
SUMMARY OF LOS ANGELES  
RUNWAY OCCUPANCY TIME DATA\*

| <u>RUNWAY</u> | <u>MEAN<br/>(seconds)</u> | <u>STD. DEV.<br/>(seconds)</u> | <u>NUMBER OF<br/>OBSERVATIONS</u> |
|---------------|---------------------------|--------------------------------|-----------------------------------|
| 24L           | 48.7                      | 7.5                            | 68                                |
| 24R           | 50.3                      | 9.4                            | 70                                |
| 25L           | 51.8                      | 10.8                           | 102                               |
| 25R           | 52.0                      | 7.7                            | 43                                |
| Overall       | 50.7                      | 9.4                            | 283                               |

TABLE 3-2  
SUMMARY OF SAN FRANCISCO  
RUNWAY OCCUPANCY TIME DATA\*

| <u>RUNWAY</u> | <u>MEAN<br/>(seconds)</u> | <u>STD. DEV.<br/>(seconds)</u> | <u>NUMBER OF<br/>OBSERVATIONS</u> |
|---------------|---------------------------|--------------------------------|-----------------------------------|
| 1L            | 30.0                      | 0.0                            | 1                                 |
| 1R            | 43.0                      | 11.7                           | 9                                 |
| 28L           | 59.6                      | 15.2                           | 120                               |
| 28R           | 56.2                      | 13.3                           | 177                               |
| Overall       | 57.1                      | 14.3                           | 307                               |

\*Small and large aircraft only.

TABLE 3-3  
SUMMARY OF DALLAS-FORT WORTH  
RUNWAY OCCUPANCY TIME DATA\*

| <u>RUNWAY</u> | <u>MEAN<br/>(seconds)</u> | <u>STD. DEV.<br/>(seconds)</u> | <u>NUMBER OF<br/>OBSERVATIONS</u> |
|---------------|---------------------------|--------------------------------|-----------------------------------|
| 17L           | 45.1                      | 8.4                            | 97                                |
| 18R           | 46.4                      | 7.1                            | 55                                |
| <hr/>         |                           |                                |                                   |
| Overall       | 45.6                      | 8.0                            | 152                               |

TABLE 3-4  
SUMMARY OF ATLANTA  
RUNWAY OCCUPANCY TIME DATA\*

| <u>RUNWAY</u> | <u>MEAN<br/>(seconds)</u> | <u>STD. DEV.<br/>(seconds)</u> | <u>NUMBER OF<br/>OBSERVATIONS</u> |
|---------------|---------------------------|--------------------------------|-----------------------------------|
| 8L            | 42.4                      | 5.0                            | 69                                |
| 9R            | 40.4                      | 5.8                            | 106                               |
| 27L           | 42.8                      | 5.7                            | 63                                |
| <hr/>         |                           |                                |                                   |
| Overall       | 41.6                      | 5.6                            | 238                               |

\* Small and Large aircraft only.

APPENDIX A  
RUNWAY OCCUPANCY TIME

This appendix contains:

- Table A-1 -- Airline Codes
- Table A-2 -- Aircraft Type Codes
- Table A-3 -- Los Angeles Runway Occupancy Time Data
- Table A-4 -- San Francisco Runway Occupancy Time Data
- Table A-5 -- Dallas-Fort Worth Runway Occupancy Time Data
- Table A-6 -- Atlanta Runway Occupancy Time Data

This data base consists of one record per aircraft, where each record is of the following form:

17L AA 02 14:34:58 14:35:45 7 47

The data items are defined as follows:

| <u>Item</u> |  |
|-------------|--|
| 1           | Runway   |
| 2           | Airline code (see Table A-1)   |
| 3           | Aircraft type code (see Table A-2)                                     |
| 4           | Time over the runway threshold (local time in hours, minutes, seconds) |
| 5           | Runway exit time (local time in hours, minutes, seconds)               |
| 6           | Exit number used   |
| 7           | Runway Occupancy Time (in seconds)                                     |

TABLE A-1  
AIRLINE CODES

|    |                                 |    |                  |
|----|---------------------------------|----|------------------|
| AA | American Airlines               | NW | Northwest Orient |
| AC | Air Canada                      | NY | New York Air     |
| AL | US Air                          | OW | National Air     |
| AO | Eastern Atlantis                | OZ | Ozark            |
| AS | Atlantic Southeast              | PA | Pan Am           |
| BA | British Airways                 | PE | People Express   |
| BN | Braniff                         | PI | Piedmont         |
| CO | Continental                     | PO | Rio Airways      |
| CR | Air Atlanta                     | QH | Air Florida      |
| DL | Delta                           | RC | Republic         |
| EA | Eastern                         | RP | Precision        |
| EC | Eagle Air                       | RZ | Ransome          |
| EM | Eastern Metro                   | SK | Skytem           |
| ER | Emery                           | ST | Stage            |
| EV | Evergreen                       | TG | Thai Airways     |
| FC | Chaparral                       | TN | air taxi         |
| FE | Federal Express                 | TS | Trans Southern   |
| FL | Frontier (and Frontier Horizon) | TV | Transamerica     |
| FT | Flying Tigers                   | TW | Transworld       |
| FY | Metroflight                     | UA | United           |
| GG | North American                  | UR | Empire           |
| IT | Interflight                     | WA | Western          |
| KL | KLM                             | WC | World Airways    |
| LH | Lufthansa                       | YX | Midwest Express  |
| ML | Midway                          | ZZ | Zantop           |
| MR | Martin Air                      |    |                  |

TABLE A-2  
AIRCRAFT TYPE CODES

|    |   |
|----|---|
| 1  | A300  |
| 2  | B727  |
| 3  | B737  |
| 4  | B747  |
| 5  | B757  |
| 6  | B767  |
| 7  | DH7   |
| 8  | F28   |
| 9  | DC9   |
| 10 | DC10  |
| 11 | L1011   |
| 12 | BAC111  |
| 13 | DH6   |
| 14 | Business Jet (Lear, Citation, Gulfstream, etc.) |
| 15 | Shorts 330                                      |
| 16 | Convair 440, YS11, MU2                          |
| 17 | Light Twin                                      |
| 18 | F27   |
| 19 | B99   |
| 20 | Convair 580                                     |
| 21 | Swearingen Metroliner                           |
| 22 | DC6   |
| 23 | DC3   |
| 24 | L188 (Lockheed Electra)                         |
| 25 | DC8, B707                                       |
| 26 | Single Engine                                   |

TABLE A-3  
LOS ANGELES RUNWAY OCCUPANCY TIME DATA

|        |    |          |          |   |    |
|--------|----|----------|----------|---|----|
| 24L    | 9  | 07:17:33 | 07:18:33 | 7 | 60 |
| 24L TW | 2  | 07:19:11 | 07:20:03 | 7 | 52 |
| 25L    | 2  | 07:22:14 | 07:23:25 | 7 | 72 |
| 24L EA | 2  | 07:27:46 | 07:28:29 | 6 | 43 |
| 24R PS | 27 | 07:28:40 | 07:29:29 | 2 | 49 |
| 25L IM | 21 | 07:30:08 | 07:30:57 | 5 | 49 |
| 25L MI | 14 | 07:31:34 | 07:32:43 | 7 | 69 |
| 25L WA | 2  | 07:35:23 | 07:36:16 | 5 | 53 |
| 24R SA | 27 | 07:35:47 | 07:36:36 | 2 | 49 |
| 25R WA | 3  | 07:38:47 | 07:39:29 | 5 | 42 |
| 25L IM | 27 | 07:39:41 | 07:40:27 | 3 | 46 |
| 25L DE | 21 | 07:41:02 | 07:42:07 | 6 | 65 |
| 24L PS | 9  | 07:43:25 | 07:44:36 | 7 | 71 |
| 24R UA | 2  | 07:45:01 | 07:46:04 | 3 | 63 |
| 25L GA | 17 | 07:46:27 | 07:47:04 | 2 | 37 |
| 24L PS | 9  | 07:47:37 | 07:48:29 | 6 | 52 |
| 25L SA | 21 | 07:49:07 | 07:50:11 | 5 | 64 |
| 24L PS | 9  | 07:51:15 | 07:51:58 | 5 | 43 |
| 24R WW | 19 | 07:51:23 | 07:52:18 | 2 | 55 |
| 24R WW | 13 | 07:56:48 | 07:57:26 | 1 | 38 |
| 25R NN | 19 | 07:57:49 | 07:58:46 | 2 | 57 |
| 24L OC | 3  | 07:58:41 | 07:59:27 | 5 | 46 |
| 24L PS | 9  | 07:59:44 | 08:00:38 | 7 | 54 |
| 24R PS | 28 | 08:01:30 | 08:02:27 | 2 | 57 |
| 25R UA | 2  | 08:02:12 | 08:03:04 | 6 | 52 |
| 24L OC | 3  | 08:04:19 | 08:05:02 | 5 | 43 |
| 24L OC | 3  | 08:06:03 | 08:06:55 | 5 | 52 |
| 24R PS | 21 | 08:07:05 | 08:08:11 | 3 | 66 |
| 24R SA | 27 | 08:09:02 | 08:09:49 | 2 | 47 |
| 25L SA | 14 | 08:09:57 | 08:10:52 | 6 | 55 |
| 25L SA | 3  | 08:11:56 | 08:12:44 | 6 | 48 |
| 25L SA | 21 | 08:15:46 | 08:16:33 | 3 | 47 |
| 25R NN | 19 | 08:16:13 | 08:16:58 | 2 | 45 |
| 25R AA | 2  | 08:19:22 | 08:20:16 | 6 | 54 |
| 25R IM | 19 | 08:21:41 | 08:22:29 | 3 | 48 |
| 25L DE | 19 | 08:25:03 | 08:25:44 | 5 | 41 |
| 24L SW | 3  | 08:29:21 | 08:30:08 | 5 | 47 |
| 25R UA | 3  | 08:31:42 | 08:32:25 | 3 | 43 |
| 24L IM | 19 | 08:33:22 | 08:34:19 | 4 | 57 |
| 25R WA | 3  | 08:33:47 | 08:34:37 | 5 | 50 |
| 24L NW | 2  | 08:35:32 | 08:36:33 | 7 | 61 |



TABLE A-3  
(continued)

|           |          |          |   |    |
|-----------|----------|----------|---|----|
| 25L IM 19 | 08:36:41 | 08:37:25 | 3 | 44 |
| 25L IM 21 | 08:37:45 | 08:38:28 | 3 | 43 |
| 25R WA 3  | 08:49:37 | 08:50:23 | 6 | 46 |
| 25L IM 15 | 08:50:59 | 08:51:43 | 3 | 44 |
| 24R PS 9  | 08:52:42 | 08:53:47 | 3 | 65 |
| 25L WW 15 | 08:53:54 | 08:54:52 | 6 | 58 |
| 25L WW 2  | 08:56:48 | 08:58:01 | 7 | 73 |
| 24L SW 2  | 08:58:45 | 08:59:32 | 5 | 47 |
| 24R OC 3  | 08:59:51 | 09:00:28 | 2 | 37 |
| 24R AM 9  | 09:01:33 | 09:02:35 | 3 | 62 |
| 25L WA 2  | 09:02:06 | 09:03:11 | 7 | 65 |
| 25R WA 2  | 09:08:31 | 09:09:25 | 6 | 54 |
| 25L GA 14 | 09:09:37 | 09:10:46 | 6 | 69 |
| 24L PS 9  | 09:15:38 | 09:16:24 | 6 | 46 |
| 25L MI 14 | 09:15:47 | 09:16:38 | 4 | 51 |
| 24R IM 21 | 09:16:01 | 09:16:58 | 2 | 57 |
| 24R IM 19 | 09:17:35 | 09:18:09 | 2 | 34 |
| 25R WA 2  | 09:17:20 | 09:18:14 | 5 | 54 |
| 24R UA 2  | 09:20:18 | 09:21:15 | 3 | 57 |
| 25L GA 14 | 09:21:55 | 09:22:41 | 6 | 46 |
| 24R PS 9  | 09:22:11 | 09:23:04 | 3 | 53 |
| 25L IM 15 | 09:23:55 | 09:24:47 | 6 | 52 |
| 25L IM 15 | 09:24:50 | 09:25:30 | 3 | 40 |
| 24R WW 19 | 09:26:03 | 09:27:02 | 2 | 59 |
| 25L IM 2  | 09:26:14 | 09:27:04 | 6 | 50 |
| 25R UA 3  | 09:27:29 | 09:28:26 | 3 | 57 |
| 24R WW 19 | 09:27:47 | 09:28:35 | 2 | 48 |
| 25R WA 2  | 09:28:45 | 09:29:43 | 5 | 58 |
| 25L WA 3  | 09:29:09 | 09:30:14 | 7 | 65 |
| 25R WA 2  | 09:30:11 | 09:31:10 | 6 | 59 |
| 25L AW 3  | 09:32:11 | 09:32:56 | 6 | 45 |
| 25L DE 21 | 09:34:58 | 09:35:52 | 6 | 54 |
| 24L OC 3  | 09:37:41 | 09:38:25 | 5 | 44 |
| 24R PS 9  | 09:40:48 | 09:41:47 | 3 | 59 |
| 24R SA 21 | 09:42:13 | 09:43:20 | 3 | 67 |
| 25L CO 2  | 09:43:08 | 09:43:53 | 6 | 45 |
| 25R WA 3  | 09:44:58 | 09:45:55 | 6 | 57 |
| 25R WA 21 | 09:46:28 | 09:47:27 | 6 | 59 |
| 25L IM 27 | 09:50:44 | 09:51:32 | 3 | 48 |
| 25L RC 2  | 09:58:41 | 09:59:25 | 6 | 44 |
| 25L DL 2  | 10:00:39 | 10:01:24 | 5 | 45 |

TABLE A-3  
(continued)

|        |    |          |          |   |    |
|--------|----|----------|----------|---|----|
| 24L UA | 3  | 10:01:58 | 10:02:44 | 5 | 46 |
| 25R UA | 2  | 10:03:06 | 10:03:52 | 3 | 46 |
| 25L IM | 19 | 10:03:16 | 10:04:08 | 3 | 52 |
| 24R PS | 9  | 10:08:00 | 10:08:56 | 3 | 56 |
| 24R OC | 3  | 10:10:16 | 10:11:07 | 2 | 51 |
| 24L SW | 3  | 10:10:21 | 10:11:14 | 5 | 53 |
| 25L SA | 21 | 10:10:58 | 10:11:57 | 6 | 59 |
| 25L GA | 26 | 10:12:44 | 10:13:19 | 1 | 35 |
| 25L UA | 2  | 10:14:36 | 10:15:35 | 6 | 59 |
| 25L GA | 17 | 10:17:26 | 10:18:14 | 2 | 48 |
| 24L GA | 17 | 10:19:34 | 10:20:13 | 3 | 39 |
| 25R AA | 2  | 10:21:21 | 10:22:18 | 4 | 57 |
| 24L TW | 2  | 10:26:04 | 10:26:49 | 5 | 45 |
| 25R GA | 17 | 10:26:37 | 10:27:24 | 2 | 47 |
| 24L AM | 9  | 10:41:27 | 10:42:32 | 5 | 65 |
| 24R PS | 9  | 10:43:18 | 10:44:01 | 2 | 43 |
| 24L EA | 2  | 10:43:15 | 10:44:10 | 5 | 55 |
| 24R MI | 14 | 10:49:18 | 10:50:20 | 3 | 62 |
| 25L MX | 2  | 10:50:09 | 10:50:54 | 6 | 45 |
| 25R RC | 2  | 10:51:41 | 10:52:38 | 5 | 57 |
| 24L SW | 2  | 10:53:19 | 10:54:19 | 5 | 60 |
| 24R PS | 9  | 10:55:39 | 10:56:15 | 2 | 36 |
| 24L OC | 3  | 10:57:23 | 10:58:06 | 5 | 43 |
| 25R UA | 2  | 10:57:59 | 10:58:48 | 5 | 49 |
| 24L WA | 2  | 10:59:05 | 10:59:44 | 5 | 39 |
| 25R WA | 3  | 10:59:35 | 11:00:30 | 5 | 54 |
| 24L OC | 3  | 11:00:26 | 11:01:08 | 4 | 42 |
| 24L WW | 19 | 11:02:05 | 11:02:41 | 3 | 36 |
| 25L IM | 27 | 11:01:59 | 11:03:08 | 4 | 69 |
| 25R RC | 9  | 11:03:02 | 11:04:01 | 5 | 59 |
| 24L SW | 3  | 11:05:14 | 11:06:06 | 5 | 52 |
| 24R IM | 27 | 11:05:19 | 11:06:19 | 2 | 60 |
| 24R SA | 21 | 11:06:44 | 11:07:13 | 2 | 29 |
| 25L WW | 13 | 11:07:25 | 11:08:19 | 6 | 54 |
| 24R PS | 28 | 11:09:37 | 11:10:27 | 2 | 50 |
| 25L RC | 2  | 11:09:48 | 11:10:56 | 7 | 68 |
| 24R IM | 13 | 11:11:09 | 11:11:59 | 2 | 50 |
| 25L WA | 2  | 11:11:45 | 11:12:52 | 5 | 67 |
| 24R WW | 15 | 11:12:53 | 11:13:31 | 1 | 38 |
| 24R MC | 9  | 11:18:12 | 11:19:11 | 3 | 59 |
| 25L PI | 2  | 11:20:35 | 11:21:28 | 6 | 53 |

TABLE A-3  
(continued)

|        |    |          |          |   |    |
|--------|----|----------|----------|---|----|
| 24R CP | 3  | 11:22:07 | 11:22:54 | 2 | 47 |
| 25L FL | 3  | 11:23:13 | 11:24:14 | 6 | 61 |
| 24R IM | 19 | 11:27:52 | 11:28:50 | 2 | 58 |
| 24L PS | 9  | 11:30:36 | 11:31:26 | 6 | 50 |
| 25L GA | 17 | 11:33:25 | 11:34:08 | 2 | 43 |
| 25L WA | 3  | 11:35:07 | 11:36:03 | 7 | 56 |
| 24R SA | 21 | 11:39:23 | 11:40:21 | 2 | 58 |
| 25L WA | 2  | 11:41:24 | 11:42:11 | 6 | 47 |
| 24R AC | 2  | 11:41:32 | 11:42:35 | 3 | 63 |
| 24R WA | 3  | 11:43:14 | 11:44:07 | 3 | 53 |
| 24R AL | 2  | 11:46:31 | 11:47:09 | 2 | 38 |
| 24R GA | 13 | 11:47:59 | 11:48:52 | 2 | 53 |
| 24R GA | 17 | 11:51:05 | 11:51:55 | 2 | 50 |
| 24L PS | 9  | 11:52:01 | 11:52:40 | 5 | 39 |
| 25R UA | 2  | 11:52:07 | 11:52:54 | 5 | 47 |
| 24R WW | 19 | 11:53:54 | 11:54:30 | 1 | 36 |
| 24L WW | 21 | 11:56:29 | 11:57:26 | 4 | 57 |
| 24L OC | 3  | 11:58:44 | 11:59:34 | 5 | 50 |
| 25L IM | 27 | 11:59:06 | 11:59:52 | 5 | 46 |
| 24R SW | 3  | 12:00:50 | 12:01:41 | 2 | 51 |
| 24L OC | 3  | 12:02:56 | 12:03:47 | 5 | 51 |
| 25R WA | 2  | 12:04:12 | 12:05:10 | 6 | 58 |
| 25L IM | 27 | 12:04:38 | 12:05:27 | 5 | 49 |
| 24R DE | 19 | 12:08:26 | 12:09:34 | 2 | 68 |
| 24R WW | 19 | 12:10:09 | 12:10:42 | 1 | 33 |
| 24L SA | 21 | 12:10:28 | 12:11:09 | 4 | 41 |
| 24R WW | 19 | 12:11:14 | 12:11:45 | 1 | 31 |
| 25L GA | 17 | 12:12:20 | 12:13:25 | 6 | 65 |
| 24R GA | 17 | 12:12:46 | 12:13:37 | 2 | 51 |
| 25L AW | 2  | 12:14:10 | 12:14:55 | 6 | 45 |
| 24L PS | 9  | 12:14:25 | 12:15:10 | 5 | 45 |
| 24R NN | 21 | 12:18:53 | 12:19:43 | 2 | 50 |
| 25R AW | 3  | 12:19:14 | 12:19:58 | 5 | 44 |
| 24L PS | 9  | 12:19:52 | 12:20:32 | 5 | 40 |
| 24L OC | 3  | 12:23:20 | 12:24:20 | 5 | 60 |
| 25L WA | 3  | 12:26:05 | 12:26:57 | 6 | 52 |
| 24L GA | 14 | 12:27:31 | 12:28:21 | 5 | 50 |
| 24L MC | 9  | 12:29:13 | 12:29:50 | 5 | 37 |
| 25L IM | 15 | 12:30:33 | 12:31:21 | 3 | 48 |
| 24L PS | 9  | 12:32:37 | 12:33:25 | 5 | 48 |
| 24R SA | 21 | 12:35:28 | 12:36:18 | 2 | 50 |

TABLE A-3  
(continued)

|        |    |          |          |   |    |
|--------|----|----------|----------|---|----|
| 25R BN | 2  | 12:36:58 | 12:37:46 | 4 | 48 |
| 24R WA | 2  | 12:37:38 | 12:38:16 | 2 | 38 |
| 25L IM | 27 | 12:39:19 | 12:40:17 | 4 | 58 |
| 25L PS | 9  | 12:41:37 | 12:42:26 | 6 | 49 |
| 25L GA | 17 | 12:46:20 | 12:47:58 | 6 | 98 |
| 24R OC | 3  | 12:50:53 | 12:51:44 | 2 | 51 |
| 24L PS | 9  | 12:52:52 | 12:53:37 | 4 | 45 |
| 24R OC | 3  | 12:53:48 | 12:54:45 | 2 | 57 |
| 24L AL | 2  | 12:56:14 | 12:57:06 | 5 | 52 |
| 24R WW | 21 | 12:57:41 | 12:58:29 | 2 | 48 |
| 25L UA | 3  | 12:58:35 | 12:59:13 | 5 | 38 |
| 24L PS | 9  | 13:01:03 | 13:01:56 | 5 | 53 |
| 25L RC | 2  | 13:02:16 | 13:03:07 | 6 | 51 |
| 25L PS | 9  | 13:03:57 | 13:04:52 | 6 | 55 |
| 24L PS | 28 | 13:04:07 | 13:05:00 | 4 | 53 |
| 25R OC | 3  | 13:06:54 | 13:07:52 | 6 | 58 |
| 24R OC | 3  | 13:06:59 | 13:07:55 | 2 | 56 |
| 25L EA | 2  | 13:10:31 | 13:11:37 | 7 | 66 |
| 25R UA | 2  | 13:11:06 | 13:11:47 | 3 | 41 |
| 24L PS | 28 | 13:12:46 | 13:13:43 | 5 | 57 |
| 25L GA | 14 | 13:16:04 | 13:16:59 | 6 | 55 |
| 25L GA | 17 | 13:18:48 | 13:19:26 | 2 | 38 |
| 25L IM | 27 | 13:22:32 | 13:23:22 | 3 | 50 |
| 25L UA | 3  | 13:27:32 | 13:28:12 | 6 | 40 |
| 24L AM | 9  | 13:27:43 | 13:28:42 | 6 | 59 |
| 24R SA | 21 | 13:27:53 | 13:28:50 | 2 | 57 |
| 25L FL | 3  | 13:29:39 | 13:30:27 | 5 | 48 |
| 25L GA | 17 | 13:34:20 | 13:35:33 | 6 | 73 |
| 25L IM | 15 | 13:41:23 | 13:42:25 | 5 | 62 |
| 24R SP | 21 | 13:50:06 | 13:51:00 | 2 | 54 |
| 24L IM | 27 | 13:52:24 | 13:53:06 | 3 | 42 |
| 25R WA | 3  | 13:51:51 | 13:53:17 | 6 | 86 |
| 24R WA | 2  | 13:54:49 | 13:55:32 | 2 | 43 |
| 24R WW | 19 | 13:58:58 | 13:59:45 | 2 | 47 |
| 25R CO | 9  | 13:58:49 | 13:59:46 | 3 | 57 |
| 24L PS | 9  | 14:00:18 | 14:01:07 | 5 | 49 |
| 24L WW | 21 | 07:39:31 | 07:40:30 | 6 | 59 |
| 25L GA | 15 | 07:41:48 | 07:42:47 | 4 | 59 |
| 25R UA | 2  | 07:45:51 | 07:46:36 | 3 | 45 |
| 24R SP | 19 | 07:46:54 | 07:47:47 | 2 | 53 |
| 24L GA | 17 | 07:47:58 | 07:48:33 | 3 | 35 |

TABLE A-3  
(continued)

|        |    |          |          |   |    |
|--------|----|----------|----------|---|----|
| 24L PS | 9  | 07:51:36 | 07:52:15 | 6 | 39 |
| 25L DE | 19 | 07:53:33 | 07:54:18 | 3 | 45 |
| 24L PS | 9  | 07:57:26 | 07:58:21 | 6 | 55 |
| 24R SP | 15 | 07:58:47 | 07:59:28 | 2 | 41 |
| 24L OC | 3  | 08:03:48 | 08:04:49 | 7 | 61 |
| 24L PS | 9  | 08:06:03 | 08:06:49 | 5 | 46 |
| 24L PS | 28 | 08:08:16 | 08:09:05 | 5 | 49 |
| 24L OC | 3  | 08:09:55 | 08:10:35 | 6 | 40 |
| 25L AW | 3  | 08:13:21 | 08:14:09 | 6 | 48 |
| 24R SA | 21 | 08:14:26 | 08:15:08 | 2 | 42 |
| 25R SA | 21 | 08:15:24 | 08:16:19 | 6 | 55 |
| 25L UA | 2  | 08:17:01 | 08:17:43 | 6 | 42 |
| 25L IM | 19 | 08:20:51 | 08:21:38 | 5 | 47 |
| 25L GA | 14 | 08:23:22 | 08:24:16 | 6 | 54 |
| 25L GA | 17 | 08:25:42 | 08:26:22 | 2 | 40 |
| 25R WA | 2  | 08:26:51 | 08:27:39 | 5 | 48 |
| 25L AA | 2  | 08:28:16 | 08:29:17 | 7 | 61 |
| 25R IM | 19 | 08:30:41 | 08:31:19 | 3 | 38 |
| 25L AA | 3  | 08:35:05 | 08:35:46 | 2 | 41 |
| 25L GA | 17 | 08:38:03 | 08:38:58 | 6 | 55 |
| 25L AM | 9  | 08:39:40 | 08:40:41 | 6 | 61 |
| 25R WA | 3  | 08:45:59 | 08:46:49 | 6 | 50 |
| 24R DE | 19 | 08:48:18 | 08:49:02 | 2 | 44 |
| 25L GA | 17 | 08:49:23 | 08:50:32 | 6 | 69 |
| 25L SP | 15 | 08:51:17 | 08:52:05 | 6 | 48 |
| 24L IM | 15 | 08:52:33 | 08:53:15 | 5 | 42 |
| 25L UA | 2  | 08:54:42 | 08:55:42 | 3 | 60 |
| 25L HA | 9  | 08:59:35 | 09:00:38 | 7 | 63 |
| 25R WA | 2  | 09:05:31 | 09:06:23 | 6 | 52 |
| 25L WA | 2  | 09:06:11 | 09:06:51 | 6 | 40 |
| 24R OC | 3  | 09:11:35 | 09:12:16 | 2 | 41 |
| 25L WA | 3  | 09:11:52 | 09:12:47 | 8 | 55 |
| 25R WA | 2  | 09:14:55 | 09:15:44 | 6 | 49 |
| 24R OC | 3  | 09:16:05 | 09:17:11 | 3 | 66 |
| 24R PS | 9  | 09:18:54 | 09:19:50 | 3 | 56 |
| 25L WA | 2  | 09:19:42 | 09:20:40 | 7 | 58 |
| 24L WA | 2  | 09:20:56 | 09:21:42 | 6 | 46 |
| 25L GA | 17 | 09:21:21 | 09:23:23 | 6 | 62 |
| 25L AW | 3  | 09:25:46 | 09:26:30 | 6 | 44 |
| 24L PS | 9  | 09:27:03 | 09:27:56 | 6 | 53 |
| 25L WA | 2  | 09:27:44 | 09:28:20 | 6 | 36 |

TABLE A-3  
(concluded)

|     |    |    |          |          |   |    |
|-----|----|----|----------|----------|---|----|
| 25R | WA | 3  | 09:29:25 | 09:30:19 | 6 | 54 |
| 25L | WA | 2  | 09:30:35 | 09:31:15 | 6 | 40 |
| 24R | WW | 19 | 09:30:57 | 09:31:45 | 2 | 48 |
| 24L | SP | 19 | 09:31:24 | 09:32:00 | 3 | 36 |
| 25L | IM | 15 | 09:32:46 | 09:33:34 | 6 | 48 |
| 24L | GA | 17 | 09:33:28 | 09:34:16 | 4 | 48 |
| 24R | SA | 21 | 09:35:31 | 09:36:16 | 2 | 45 |
| 25L | CO | 2  | 09:36:53 | 09:37:29 | 6 | 36 |
| 25R | UA | 2  | 09:40:50 | 09:41:42 | 5 | 52 |
| 24L | GA | 17 | 09:41:52 | 09:42:41 | 4 | 49 |
| 25R | UA | 2  | 09:42:05 | 09:42:52 | 6 | 47 |
| 25L | GA | 14 | 09:44:23 | 09:45:13 | 6 | 50 |
| 24R | WW | 19 | 09:45:40 | 09:46:30 | 2 | 50 |
| 24R | GA | 17 | 09:47:06 | 09:47:43 | 1 | 37 |
| 25L | IM | 27 | 09:49:08 | 09:49:46 | 3 | 38 |
| 24R | SA | 21 | 09:50:03 | 09:50:51 | 2 | 48 |
| 25R | UA | 2  | 09:51:20 | 09:52:08 | 5 | 48 |
| 24L | SA | 21 | 09:56:12 | 09:57:00 | 5 | 48 |
| 25L | GA | 17 | 09:58:11 | 09:58:54 | 2 | 43 |
| 25R | IM | 21 | 09:58:46 | 09:59:43 | 6 | 57 |
| 24L | SW | 3  | 10:00:58 | 10:01:45 | 5 | 47 |
| 25L | IM | 27 | 10:01:40 | 10:02:18 | 4 | 38 |
| 24R | WW | 19 | 10:02:26 | 10:03:08 | 2 | 42 |
| 25L | DL | 2  | 10:03:29 | 10:04:12 | 6 | 43 |
| 25L | UA | 2  | 10:05:14 | 10:06:08 | 6 | 54 |
| 24L | TW | 2  | 10:06:58 | 10:07:45 | 6 | 47 |
| 24R | PS | 9  | 10:08:27 | 10:09:25 | 3 | 58 |
| 25L | SA | 27 | 10:10:20 | 10:11:05 | 6 | 45 |
| 24L | OC | 3  | 10:12:24 | 10:13:17 | 6 | 53 |
| 24L | PS | 9  | 10:13:59 | 10:14:44 | 6 | 45 |
| 24L | OC | 3  | 10:16:50 | 10:17:36 | 6 | 46 |
| 25L | GA | 17 | 10:17:56 | 10:18:28 | 2 | 32 |
| 25L | UA | 2  | 10:19:29 | 10:20:14 | 6 | 45 |
| 25L | PI | 2  | 10:21:45 | 10:22:44 | 7 | 59 |
| 25L | WA | 3  | 10:23:20 | 10:24:14 | 7 | 54 |
| 25L | RC | 2  | 10:25:00 | 10:25:39 | 6 | 39 |
| 24R | PS | 9  | 10:26:30 | 10:27:23 | 3 | 53 |

TABLE A-4  
SAN FRANCISCO RUNWAY OCCUPANCY TIME DATA

|        |    |          |          |    |     |
|--------|----|----------|----------|----|-----|
| 28R NW | 2  | 14:28:52 | 14:29:49 | 6  | 57  |
| 28L WS | 13 | 14:31:20 | 14:33:00 | 9  | 100 |
| 28R PS | 9  | 14:37:44 | 14:38:29 | 6  | 45  |
| 28L OC | 3  | 14:43:49 | 14:44:56 | 7  | 67  |
| 28L OC | 14 | 14:45:41 | 14:47:05 | 10 | 84  |
| 28L GA | 14 | 14:51:40 | 14:52:52 | 10 | 72  |
| 28R WW | 19 | 14:53:52 | 14:54:52 | 6  | 60  |
| 28L WS | 13 | 14:57:24 | 14:58:39 | 8  | 75  |
| 28R PS | 28 | 15:00:21 | 15:01:19 | 6  | 58  |
| 28R AS | 2  | 15:01:37 | 15:02:27 | 6  | 50  |
| 28R FL | 2  | 15:03:28 | 15:04:22 | 6  | 54  |
| 28L PS | 9  | 15:04:42 | 15:05:26 | 5  | 44  |
| 28L UA | 2  | 15:06:13 | 15:07:22 | 8  | 69  |
| 28R UA | 3  | 15:09:21 | 15:10:13 | 7  | 52  |
| 28R WW | 21 | 15:13:22 | 15:14:14 | 6  | 52  |
| 28R UA | 2  | 15:14:33 | 15:15:18 | 6  | 45  |
| 28L PS | 9  | 15:21:27 | 15:22:08 | 5  | 41  |
| 28L UA | 3  | 15:25:54 | 15:26:59 | 7  | 65  |
| 28R UA | 2  | 15:27:47 | 15:28:44 | 7  | 57  |
| 28L PS | 9  | 15:32:40 | 15:33:25 | 5  | 45  |
| 28R UA | 2  | 15:35:27 | 15:36:19 | 6  | 52  |
| 28R UA | 2  | 15:35:27 | 15:36:19 | 6  | 52  |
| 28L PS | 9  | 15:39:09 | 15:40:01 | 6  | 52  |
| 28L PS | 9  | 15:41:57 | 15:42:52 | 6  | 55  |
| 28L WA | 2  | 15:44:12 | 15:44:48 | 5  | 36  |
| 28R GA | 26 | 15:43:34 | 15:44:55 | 8  | 81  |
| 28L UA | 3  | 15:46:54 | 15:47:56 | 7  | 62  |
| 28L GA | 14 | 15:48:06 | 15:48:58 | 7  | 52  |
| 28L SW | 3  | 15:50:03 | 15:50:46 | 5  | 43  |
| 28L PS | 9  | 15:59:01 | 16:00:06 | 7  | 65  |
| 28L GA | 14 | 16:01:21 | 16:02:15 | 5  | 54  |
| 28L PS | 9  | 16:04:36 | 16:05:15 | 5  | 39  |
| 28R WS | 13 | 16:06:09 | 16:07:08 | 7  | 59  |
| 28L PS | 9  | 16:09:04 | 16:09:55 | 5  | 51  |
| 28R WW | 15 | 16:10:19 | 16:11:05 | 6  | 46  |
| 28L GA | 14 | 16:10:47 | 16:11:58 | 10 | 71  |
| 28R GA | 17 | 16:12:14 | 16:13:19 | 6  | 65  |
| 28L NN | 19 | 16:12:40 | 16:13:28 | 6  | 48  |
| 28L PS | 9  | 16:14:15 | 16:15:11 | 6  | 56  |
| 28R UA | 3  | 16:17:11 | 16:17:57 | 6  | 46  |
| 28L PS | 9  | 16:17:18 | 16:18:00 | 5  | 42  |

TABLE A-4  
(continued)

|     |    |    |          |          |    |    |
|-----|----|----|----------|----------|----|----|
| 28R | OC | 9  | 16:19:22 | 16:20:13 | 6  | 51 |
| 28L | PS | 28 | 16:19:31 | 16:20:21 | 5  | 50 |
| 28R | GA | 14 | 16:21:35 | 16:23:10 | 7  | 95 |
| 28R | RC | 2  | 16:23:38 | 16:24:30 | 5  | 52 |
| 28L | OC | 9  | 16:24:20 | 16:25:07 | 6  | 47 |
| 28L | WA | 3  | 16:25:37 | 16:26:28 | 6  | 51 |
| 28R | UA | 3  | 16:27:19 | 16:28:05 | 6  | 46 |
| 28L | WA | 2  | 16:27:56 | 16:28:38 | 5  | 42 |
| 28L | UA | 2  | 16:29:48 | 16:31:07 | 8  | 79 |
| 28L | WW | 21 | 16:31:50 | 16:32:57 | 7  | 67 |
| 28R | GA | 14 | 16:31:30 | 16:33:08 | 10 | 98 |
| 28L | UA | 2  | 16:33:32 | 16:34:17 | 5  | 45 |
| 28L | UA | 3  | 16:35:43 | 16:36:55 | 7  | 72 |
| 28R | GA | 17 | 16:36:49 | 16:37:36 | 6  | 47 |
| 28L | NW | 2  | 16:37:13 | 16:38:19 | 7  | 66 |
| 28R | WS | 15 | 16:37:57 | 16:38:54 | 7  | 57 |
| 28L | AS | 2  | 16:39:04 | 16:39:56 | 5  | 52 |
| 28R | WW | 19 | 16:40:46 | 16:41:40 | 6  | 54 |
| 28L | NN | 13 | 16:40:54 | 16:42:19 | 8  | 85 |
| 28R | UA | 2  | 16:42:13 | 16:43:03 | 6  | 50 |
| 28L | OC | 3  | 16:43:31 | 16:44:32 | 7  | 61 |
| 28R | GA | 17 | 16:43:50 | 16:45:09 | 10 | 79 |
| 28L | AL | 2  | 16:45:59 | 16:46:43 | 6  | 44 |
| 28L | OC | 3  | 16:47:58 | 16:49:07 | 7  | 69 |
| 28L | WS | 15 | 16:52:00 | 16:52:56 | 7  | 56 |
| 28L | UA | 3  | 16:53:03 | 16:54:12 | 7  | 69 |
| 28L | HO | 18 | 17:02:49 | 17:03:46 | 5  | 57 |
| 28L | UA | 2  | 17:04:46 | 17:05:58 | 8  | 72 |
| 28R | SW | 3  | 17:06:34 | 17:07:32 | 6  | 58 |
| 28L | UA | 3  | 14:43:54 | 14:45:05 | 8  | 71 |
| 28L | WW | 21 | 14:52:05 | 14:53:12 | 7  | 67 |
| 28R | PS | 9  | 14:55:53 | 14:56:45 | 5  | 52 |
| 28L | AS | 2  | 14:59:21 | 15:00:04 | 5  | 43 |
| 28R | PS | 9  | 15:03:42 | 15:04:31 | 6  | 49 |
| 28R | GA | 26 | 15:06:55 | 15:08:09 | 10 | 74 |
| 28R | UA | 2  | 15:08:43 | 15:09:42 | 6  | 59 |
| 28L | GA | 14 | 15:09:02 | 15:10:28 | 10 | 86 |
| 28R | UA | 3  | 15:20:53 | 15:22:01 | 6  | 68 |
| 28L | WA | 2  | 15:25:37 | 15:26:14 | 5  | 37 |
| 28L | PS | 9  | 15:26:56 | 15:27:44 | 6  | 48 |
| 28L | PS | 9  | 15:30:46 | 15:31:36 | 6  | 50 |



TABLE A-4  
(continued)

|        |    |          |          |    |    |
|--------|----|----------|----------|----|----|
| 28L PS | 9  | 15:32:54 | 15:34:03 | 7  | 69 |
| 28L WW | 21 | 15:39:23 | 15:40:10 | 5  | 47 |
| 28L SW | 3  | 15:42:12 | 15:42:56 | 5  | 44 |
| 28L WW | 19 | 15:44:40 | 15:45:26 | 5  | 46 |
| 28L GA | 14 | 15:51:00 | 15:52:18 | 10 | 78 |
| 28L GA | 14 | 15:54:26 | 15:55:30 | 6  | 64 |
| 28L GA | 17 | 15:56:37 | 15:57:38 | 8  | 61 |
| 28L PS | 9  | 15:59:34 | 16:00:25 | 6  | 51 |
| 28L PS | 28 | 16:04:39 | 16:05:25 | 5  | 46 |
| 28R PS | 9  | 16:04:43 | 16:05:30 | 6  | 47 |
| 28L WW | 21 | 16:05:55 | 16:06:41 | 5  | 46 |
| 28R CO | 2  | 16:06:08 | 16:06:57 | 6  | 49 |
| 28L PS | 9  | 16:08:06 | 16:08:53 | 6  | 47 |
| 28R PS | 9  | 16:08:14 | 16:09:02 | 6  | 48 |
| 28L UA | 3  | 16:10:40 | 16:11:23 | 5  | 43 |
| 28R WS | 15 | 16:14:32 | 16:15:28 | 6  | 56 |
| 28L OC | 9  | 16:15:19 | 16:16:30 | 7  | 71 |
| 28R GA | 19 | 16:15:32 | 16:16:53 | 10 | 81 |
| 28L UA | 3  | 16:16:50 | 16:17:57 | 8  | 67 |
| 28R UA | 3  | 16:18:15 | 16:19:03 | 6  | 48 |
| 28R WD | 17 | 16:19:19 | 16:20:09 | 6  | 50 |
| 28L PS | 9  | 16:21:32 | 16:22:35 | 7  | 63 |
| 28R GA | 14 | 16:21:35 | 16:22:53 | 10 | 78 |
| 28R RC | 2  | 16:23:25 | 16:24:17 | 6  | 52 |
| 28L GA | 14 | 16:23:39 | 16:24:37 | 6  | 58 |
| 28R UA | 2  | 16:25:01 | 16:26:01 | 6  | 60 |
| 28L UA | 2  | 16:25:35 | 16:26:27 | 7  | 52 |
| 28R OC | 9  | 16:26:45 | 16:27:32 | 6  | 47 |
| 28L WS | 13 | 16:27:54 | 16:28:50 | 5  | 56 |
| 28L UA | 3  | 16:29:25 | 16:30:31 | 6  | 66 |
| 28R UA | 2  | 16:30:51 | 16:31:41 | 6  | 50 |
| 28L WS | 15 | 16:32:40 | 16:33:19 | 5  | 39 |
| 28R WS | 15 | 16:32:49 | 16:33:38 | 6  | 49 |
| 28L UA | 3  | 16:33:59 | 16:35:24 | 8  | 85 |
| 28R AL | 2  | 16:38:46 | 16:39:47 | 6  | 61 |
| 28L UA | 2  | 16:39:11 | 16:40:28 | 7  | 77 |
| 28L AS | 2  | 16:41:06 | 16:41:55 | 6  | 49 |
| 28R OC | 3  | 16:45:06 | 16:45:57 | 6  | 51 |
| 28L OC | 3  | 16:53:00 | 16:54:11 | 7  | 71 |
| 28L SW | 3  | 16:55:24 | 16:56:10 | 5  | 46 |
| 28R WA | 3  | 16:57:51 | 16:58:43 | 7  | 52 |

TABLE A-4  
(continued)

|     |    |    |          |          |    |     |
|-----|----|----|----------|----------|----|-----|
| 28L | GA | 14 | 16:58:18 | 16:59:27 | 7  | 69  |
| 28L | UA | 3  | 16:59:46 | 17:00:31 | 5  | 45  |
| 28L | HO | 18 | 17:00:59 | 17:01:45 | 5  | 46  |
| 28R | OC | 3  | 17:05:05 | 17:05:58 | 6  | 53  |
| 28R | UA | 3  | 17:09:06 | 17:09:58 | 6  | 52  |
| 28L | UA | 3  | 17:10:37 | 17:11:40 | 7  | 63  |
| 28L | UA | 3  | 17:12:12 | 17:13:10 | 8  | 58  |
| 28L | UA | 2  | 17:15:02 | 17:15:42 | 5  | 40  |
| 28R | UA | 2  | 17:14:59 | 17:16:03 | 6  | 64  |
| 28R | UA | 3  | 17:17:32 | 17:18:22 | 6  | 50  |
| 28L | PS | 9  | 17:18:15 | 17:18:57 | 5  | 42  |
| 28R | UA | 3  | 17:20:40 | 17:21:36 | 6  | 56  |
| 28R | UA | 3  | 17:23:57 | 17:24:49 | 6  | 52  |
| 28L | UA | 2  | 17:27:52 | 17:29:12 | 8  | 80  |
| 28L | PS | 9  | 17:29:59 | 17:30:43 | 5  | 44  |
| 28R | GA | 17 | 17:30:05 | 17:30:58 | 6  | 53  |
| 28L | GA | 17 | 17:33:07 | 17:34:53 | 10 | 106 |
| 28L | GA | 14 | 17:37:00 | 17:37:53 | 5  | 53  |
| 28R | AA | 2  | 17:38:41 | 17:39:37 | 6  | 56  |
| 28L | OC | 3  | 17:41:03 | 17:42:28 | 7  | 85  |
| 28L | WW | 21 | 17:42:37 | 17:43:25 | 6  | 48  |
| 28L | WW | 21 | 17:43:54 | 17:44:50 | 5  | 56  |
| 28R | CO | 2  | 17:45:50 | 17:46:45 | 6  | 55  |
| 28R | GA | 17 | 17:47:10 | 17:48:29 | 6  | 79  |
| 28L | WW | 21 | 17:47:37 | 17:48:43 | 5  | 66  |
| 28L | UA | 2  | 17:49:40 | 17:50:20 | 5  | 40  |
| 28L | GA | 17 | 17:53:05 | 17:54:11 | 5  | 66  |
| 28R | GA | 23 | 17:53:54 | 17:55:20 | 6  | 86  |
| 28L | UA | 3  | 17:55:01 | 17:56:29 | 8  | 88  |
| 28R | CP | 3  | 17:58:37 | 17:59:33 | 5  | 56  |
| 28L | PS | 9  | 17:59:30 | 18:00:10 | 5  | 40  |
| 28L | PS | 9  | 18:04:22 | 18:05:14 | 5  | 52  |
| 28R | GA | 17 | 18:04:50 | 18:06:05 | 9  | 75  |
| 28L | WA | 2  | 18:06:34 | 18:07:14 | 5  | 40  |
| 28L | WW | 21 | 18:08:40 | 18:09:37 | 5  | 57  |
| 28R | WS | 13 | 18:09:00 | 18:09:58 | 6  | 58  |
| 28R | NW | 2  | 18:10:53 | 18:11:33 | 6  | 40  |
| 28L | GA | 14 | 18:11:03 | 18:12:38 | 9  | 95  |
| 28L | OC | 3  | 18:25:29 | 18:26:53 | 6  | 84  |
| 28L | GA | 14 | 18:30:37 | 18:31:31 | 5  | 54  |
| 28L | PS | 9  | 18:32:42 | 18:33:32 | 5  | 50  |

TABLE A-4  
(continued)

|     |    |    |          |          |   |     |
|-----|----|----|----------|----------|---|-----|
| 28R | WA | 2  | 18:33:24 | 18:34:06 | 6 | 42  |
| 28R | GA | 14 | 18:34:53 | 18:35:58 | 6 | 65  |
| 28L | MX | 2  | 18:36:09 | 18:37:02 | 6 | 53  |
| 28L | SW | 3  | 18:38:47 | 18:39:36 | 5 | 49  |
| 28R | GA | 17 | 18:39:10 | 18:40:35 | 7 | 85  |
| 28R | UA | 2  | 18:41:57 | 18:42:44 | 6 | 47  |
| 28L | GA | 14 | 18:41:46 | 18:43:13 | 8 | 87  |
| 28R | NN | 2  | 18:46:05 | 18:47:21 | 7 | 76  |
| 28L | UA | 3  | 18:49:55 | 18:51:09 | 7 | 74  |
| 28R | RC | 9  | 18:55:59 | 18:57:08 | 6 | 69  |
| 28R | CO | 2  | 19:01:04 | 19:02:05 | 6 | 61  |
| 28L | PS | 9  | 19:01:34 | 19:02:21 | 5 | 47  |
| 28R | WS | 21 | 19:02:56 | 19:04:08 | 6 | 72  |
| 28L | RC | 9  | 19:08:05 | 19:08:56 | 5 | 51  |
| 28R | GA | 26 | 19:08:14 | 19:10:08 | 8 | 114 |
| 28L | OC | 3  | 19:10:23 | 19:11:46 | 7 | 83  |
| 28L | UA | 3  | 19:12:36 | 19:13:58 | 8 | 82  |
| 28R | UA | 2  | 19:13:34 | 19:14:23 | 6 | 49  |
| 28L | PS | 9  | 19:16:37 | 19:17:29 | 5 | 52  |
| 28L | PS | 9  | 19:18:08 | 19:18:55 | 5 | 47  |
| 28R | GA | 26 | 19:19:38 | 19:21:14 | 6 | 96  |
| 28L | PS | 9  | 19:20:36 | 19:21:41 | 7 | 65  |
| 28R | GA | 23 | 19:21:27 | 19:23:11 | 8 | 104 |
| 28L | AS | 2  | 19:22:55 | 19:23:46 | 5 | 51  |
| 28R | GA | 17 | 19:23:20 | 19:24:36 | 8 | 76  |
| 28L | WS | 15 | 19:27:27 | 19:28:22 | 5 | 55  |
| 28R | PS | 28 | 19:27:44 | 19:29:04 | 6 | 80  |
| 28L | PS | 9  | 19:30:07 | 19:30:54 | 5 | 47  |
| 28L | WW | 21 | 19:31:11 | 19:32:23 | 7 | 72  |
| 28L | OC | 3  | 19:33:08 | 19:34:13 | 6 | 65  |
| 28R | WS | 15 | 19:35:02 | 19:36:18 | 6 | 76  |
| 28L | OC | 9  | 19:35:25 | 19:36:37 | 7 | 72  |
| 28R | WS | 17 | 19:37:50 | 19:39:23 | 9 | 93  |
| 28L | OC | 3  | 19:41:56 | 19:43:14 | 8 | 78  |
| 28L | AC | 2  | 19:43:27 | 19:44:22 | 5 | 55  |
| 28L | AA | 2  | 19:46:56 | 19:48:21 | 6 | 85  |
| 28R | TW | 2  | 19:49:07 | 19:50:16 | 6 | 69  |
| 28R | WS | 15 | 10:00:08 | 10:00:54 | 6 | 46  |
| 28R | UA | 3  | 10:01:52 | 10:02:51 | 6 | 59  |
| 28R | PS | 9  | 10:10:35 | 10:11:21 | 6 | 46  |
| 28R | NS | 17 | 10:13:23 | 10:13:59 | 6 | 36  |

TABLE A-4  
(continued)

|        |    |          |          |   |    |
|--------|----|----------|----------|---|----|
| 28R NS | 17 | 10:14:11 | 10:15:05 | 6 | 54 |
| 28R AA | 2  | 10:16:43 | 10:17:26 | 6 | 43 |
| 28R AA | 2  | 10:17:51 | 10:18:37 | 6 | 46 |
| 28R DL | 2  | 10:20:24 | 10:21:14 | 6 | 50 |
| 28R PS | 9  | 10:23:09 | 10:23:59 | 6 | 50 |
| 28R UA | 3  | 10:25:51 | 10:26:44 | 6 | 53 |
| 28R FL | 2  | 10:27:29 | 10:28:22 | 6 | 53 |
| 28R WW | 21 | 10:29:10 | 10:30:11 | 6 | 61 |
| 28R SW | 3  | 10:31:16 | 10:32:17 | 6 | 61 |
| 28R GA | 19 | 10:36:49 | 10:37:39 | 6 | 50 |
| 28R OC | 3  | 10:39:57 | 10:40:38 | 6 | 41 |
| 28R UA | 2  | 10:43:02 | 10:43:50 | 6 | 48 |
| 28R RC | 2  | 10:47:12 | 10:48:04 | 6 | 52 |
| 28R GA | 17 | 10:51:27 | 10:52:16 | 6 | 49 |
| 28R UA | 2  | 10:54:50 | 10:55:38 | 6 | 48 |
| 28R PS | 9  | 10:56:22 | 10:57:15 | 6 | 53 |
| 28R WW | 21 | 10:58:16 | 10:58:56 | 6 | 40 |
| 28R CO | 2  | 11:07:46 | 11:08:42 | 6 | 56 |
| 28R GA | 17 | 11:10:11 | 11:10:51 | 6 | 40 |
| 28R GA | 14 | 11:11:31 | 11:12:19 | 6 | 48 |
| 28R EA | 2  | 11:12:56 | 11:13:48 | 6 | 52 |
| 28R OC | 9  | 11:14:28 | 11:15:10 | 6 | 42 |
| 28R PA | 2  | 11:15:48 | 11:16:42 | 5 | 54 |
| 28R WA | 2  | 11:17:21 | 11:18:07 | 5 | 46 |
| 28R SO | 21 | 11:19:51 | 11:20:37 | 6 | 46 |
| 28R PI | 2  | 11:20:45 | 11:21:38 | 6 | 53 |
| 28R OC | 3  | 11:22:10 | 11:22:59 | 6 | 49 |
| 28R WW | 21 | 11:26:19 | 11:27:00 | 6 | 41 |
| 28R AC | 2  | 11:27:26 | 11:28:25 | 6 | 59 |
| 28R WW | 15 | 11:28:29 | 11:29:18 | 6 | 49 |
| 28R UA | 3  | 11:30:22 | 11:31:15 | 6 | 53 |
| 28R PS | 9  | 11:34:01 | 11:35:09 | 6 | 68 |
| 28R WW | 21 | 11:37:34 | 11:38:28 | 6 | 54 |
| 28R SO | 21 | 11:38:43 | 11:39:43 | 6 | 60 |
| 28R GA | 26 | 11:41:38 | 11:42:41 | 6 | 63 |
| 28R PA | 2  | 11:45:29 | 11:46:26 | 6 | 57 |
| 28R OC | 3  | 11:46:48 | 11:47:44 | 6 | 56 |
| 28R UA | 3  | 11:50:10 | 11:51:00 | 6 | 50 |
| 28R DL | 2  | 11:52:01 | 11:52:59 | 6 | 58 |
| 28R WA | 2  | 11:53:38 | 11:54:28 | 6 | 50 |
| 28R RC | 2  | 11:55:13 | 11:56:09 | 6 | 56 |

TABLE A-4  
(continued)

|        |    |          |          |   |    |
|--------|----|----------|----------|---|----|
| 28R OC | 3  | 11:56:53 | 11:57:47 | 6 | 54 |
| 28R PA | 2  | 11:58:09 | 11:59:00 | 6 | 51 |
| 28R AL | 2  | 12:02:07 | 12:03:08 | 6 | 61 |
| 28R PS | 9  | 12:03:45 | 12:04:36 | 6 | 51 |
| 28R WW | 21 | 12:05:10 | 12:06:08 | 6 | 58 |
| 28R PS | 28 | 12:07:06 | 12:08:03 | 6 | 57 |
| 28R PI | 2  | 12:08:38 | 12:09:32 | 6 | 54 |
| 28R CP | 3  | 12:14:13 | 12:15:16 | 6 | 63 |
| 28R PS | 9  | 12:18:05 | 12:18:49 | 5 | 44 |
| 28R UA | 3  | 12:19:32 | 12:20:22 | 6 | 50 |
| 28R CO | 2  | 12:20:41 | 12:21:28 | 6 | 47 |
| 28R PS | 9  | 12:22:57 | 12:23:45 | 6 | 48 |
| 01R WW | 15 | 12:23:36 | 12:24:07 | 2 | 31 |
| 01L GA | 17 | 12:23:54 | 12:24:24 | 2 | 30 |
| 28R UA | 2  | 12:24:27 | 12:25:21 | 6 | 54 |
| 28R UA | 2  | 12:28:06 | 12:28:53 | 6 | 47 |
| 28R PS | 9  | 12:29:49 | 12:30:30 | 5 | 41 |
| 28R UA | 2  | 12:33:07 | 12:33:54 | 6 | 47 |
| 01R GA | 3  | 12:35:53 | 12:36:46 | 3 | 53 |
| 28R PS | 9  | 12:37:07 | 12:38:07 | 6 | 60 |
| 01R WW | 15 | 12:38:19 | 12:39:05 | 2 | 46 |
| 01R GA | 26 | 12:40:42 | 12:41:12 | 1 | 30 |
| 28R UA | 3  | 12:42:05 | 12:42:56 | 7 | 51 |
| 28R PS | 9  | 12:43:39 | 12:44:31 | 6 | 52 |
| 28R UA | 3  | 12:47:41 | 12:48:26 | 6 | 45 |
| 28R WA | 3  | 12:48:55 | 12:49:43 | 6 | 48 |
| 28R PS | 9  | 12:52:47 | 12:53:42 | 6 | 55 |
| 28R GA | 17 | 12:54:18 | 12:55:16 | 3 | 58 |
| 28R UA | 3  | 12:55:43 | 12:56:39 | 6 | 56 |
| 28R NW | 2  | 12:57:01 | 12:57:49 | 6 | 48 |
| 28R UA | 3  | 12:58:27 | 12:59:19 | 6 | 52 |
| 28R SO | 21 | 13:00:31 | 13:01:07 | 4 | 36 |
| 28R UA | 3  | 13:01:11 | 13:01:53 | 6 | 42 |
| 28R UA | 3  | 13:03:01 | 13:03:51 | 6 | 50 |
| 28R OC | 3  | 13:04:30 | 13:05:21 | 6 | 51 |
| 28R UA | 2  | 13:05:45 | 13:06:40 | 7 | 55 |
| 28R EA | 2  | 13:06:58 | 13:07:45 | 6 | 47 |
| 28R PS | 9  | 13:08:10 | 13:08:59 | 6 | 49 |
| 01R WW | 19 | 13:10:21 | 13:10:59 | 2 | 38 |
| 01R WS | 13 | 13:12:07 | 13:13:04 | 2 | 57 |
| 28R PS | 28 | 13:12:29 | 13:13:21 | 6 | 52 |

TABLE A-4  
(concluded)

|     |    |    |          |          |   |    |
|-----|----|----|----------|----------|---|----|
| 01R | WS | 13 | 13:17:08 | 13:18:04 | 2 | 56 |
| 28R | UA | 3  | 13:17:44 | 13:18:33 | 6 | 49 |
| 28R | PS | 9  | 13:19:43 | 13:20:33 | 6 | 50 |
| 01R | WS | 13 | 13:24:06 | 13:25:05 | 2 | 59 |
| 01R | WW | 21 | 13:26:18 | 13:26:53 | 2 | 35 |
| 28R | BN | 2  | 13:26:41 | 13:27:35 | 7 | 54 |
| 28R | SO | 21 | 13:28:41 | 13:29:35 | 6 | 54 |
| 28R | UA | 2  | 13:30:03 | 13:30:51 | 6 | 48 |
| 28R | UA | 3  | 13:32:14 | 13:32:56 | 6 | 42 |
| 28R | UA | 3  | 13:34:30 | 13:35:21 | 6 | 51 |
| 28R | OC | 3  | 13:36:42 | 13:38:14 | 8 | 92 |
| 28R | GA | 17 | 13:38:29 | 13:40:07 | 9 | 98 |
| 28R | DL | 2  | 13:41:09 | 13:41:50 | 6 | 41 |
| 28R | PS | 9  | 13:43:03 | 13:43:50 | 6 | 47 |
| 28R | AS | 2  | 13:44:34 | 13:45:24 | 6 | 50 |
| 28R | GA | 14 | 13:46:35 | 13:47:32 | 6 | 57 |
| 28R | OC | 3  | 13:48:39 | 13:49:34 | 6 | 55 |
| 28R | GA | 14 | 13:50:06 | 13:50:57 | 6 | 51 |
| 28R | GA | 17 | 13:51:40 | 13:52:35 | 5 | 55 |
| 28R | GA | 17 | 13:55:56 | 13:56:52 | 6 | 56 |

TABLE A-5  
DALLAS-FORT WORTH RUNWAY OCCUPANCY TIME DATA

|           |          |          |    |     |
|-----------|----------|----------|----|-----|
| 17L AA 09 | 14:33:24 | 14:34:00 | 02 | 36  |
| 17L AA 02 | 14:34:58 | 14:35:45 | 03 | 47  |
| 17L AA 09 | 14:36:30 | 14:37:10 | 03 | 40  |
| 17L AA 02 | 14:38:20 | 14:39:10 | 03 | 50  |
| 17L AA 02 | 14:39:47 | 14:40:33 | 03 | 46  |
| 17L AA 02 | 14:42:10 | 14:42:50 | 02 | 40  |
| 17L AA 02 | 14:43:23 | 14:44:10 | 02 | 47  |
| 17L AA 09 | 14:45:24 | 14:45:56 | 02 | 32  |
| 17L AA 02 | 14:46:35 | 14:47:17 | 03 | 42  |
| 17L FY 13 | 14:48:50 | 14:49:26 | 02 | 36  |
| 17L FY 20 | 14:51:21 | 14:52:05 | 02 | 44  |
| 17L AA 02 | 14:52:46 | 14:53:30 | 03 | 44  |
| 17L AA 02 | 14:54:22 | 14:54:58 | 03 | 36  |
| 17L FC 19 | 14:56:04 | 14:56:45 | 02 | 41  |
| 17L SK 21 | 14:57:36 | 14:58:20 | 02 | 44  |
| 17L AA 10 | 14:59:28 | 15:00:15 | 03 | 47  |
| 17L AA 02 | 15:01:24 | 15:02:14 | 03 | 50  |
| 17L ZZ 25 | 15:02:40 | 15:03:56 | 04 | 76  |
| 17L CO 09 | 15:05:38 | 15:06:15 | 03 | 37  |
| 17L GA 21 | 15:07:07 | 15:07:50 | 02 | 43  |
| 17L GA 14 | 15:10:20 | 15:10:53 | 02 | 33  |
| 17L ZZ 25 | 15:11:36 | 15:12:57 | 04 | 81  |
| 17L GA 14 | 15:15:20 | 15:16:03 | 02 | 43  |
| 17L DL 02 | 15:17:05 | 15:18:00 | 03 | 55  |
| 17L DL 03 | 15:20:48 | 15:21:40 | 03 | 52  |
| 17L PO 19 | 15:22:10 | 15:22:48 | 02 | 38  |
| 17L PI 02 | 15:23:24 | 15:23:54 | 02 | 30  |
| 17L TG 04 | 15:25:32 | 15:27:21 | 02 | 109 |
| 17L DL 03 | 15:28:18 | 15:28:57 | 02 | 39  |
| 17L DL 03 | 15:30:36 | 15:31:20 | 03 | 44  |
| 18R AA 09 | 14:40:36 | 14:41:20 | 04 | 44  |
| 18R AA 02 | 14:44:26 | 14:45:20 | 04 | 54  |
| 18R AA 02 | 14:46:02 | 14:46:45 | 04 | 43  |
| 18R IT 25 | 14:47:52 | 14:48:40 | 04 | 48  |
| 18R AA 02 | 14:49:43 | 14:50:37 | 04 | 54  |
| 18R AA 02 | 14:51:05 | 14:51:54 | 04 | 49  |
| 18R AA 02 | 14:52:29 | 14:53:10 | 04 | 41  |
| 18R AA 02 | 14:54:10 | 14:54:56 | 04 | 46  |
| 18R AA 10 | 14:55:35 | 14:56:08 | 04 | 33  |
| 18R AA 02 | 14:57:35 | 14:58:17 | 04 | 42  |
| 18R AA 02 | 15:01:23 | 15:01:56 | 02 | 33  |

TABLE A-5  
(continued)

|     |    |    |          |          |    |    |
|-----|----|----|----------|----------|----|----|
| 18R | FC | 19 | 15:04:12 | 15:05:04 | 02 | 52 |
| 18R | GA | 19 | 15:06:18 | 15:07:03 | 01 | 45 |
| 18R | PA | 02 | 15:08:30 | 15:09:10 | 02 | 40 |
| 18R | UA | 02 | 15:19:40 | 15:20:30 | 04 | 50 |
| 17L | AA | 10 | 15:53:52 | 15:54:45 | 03 | 53 |
| 17L | AA | 02 | 15:56:14 | 15:56:45 | 02 | 31 |
| 17L | FY | 20 | 16:00:00 | 16:00:31 | 02 | 31 |
| 17L | AA | 02 | 16:00:57 | 16:01:35 | 02 | 38 |
| 17L | AA | 02 | 16:02:14 | 16:02:52 | 02 | 38 |
| 17L | AA | 02 | 16:06:05 | 16:06:47 | 03 | 42 |
| 17L | AA | 09 | 16:07:17 | 16:08:06 | 03 | 49 |
| 17L | AA | 02 | 16:09:11 | 16:09:58 | 03 | 47 |
| 17L | AA | 02 | 16:10:16 | 16:10:58 | 03 | 42 |
| 17L | AA | 02 | 16:11:44 | 16:12:26 | 03 | 42 |
| 17L | AA | 02 | 16:13:10 | 16:13:58 | 03 | 48 |
| 17L | AA | 02 | 16:15:00 | 16:15:50 | 03 | 50 |
| 17L | AA | 02 | 16:17:00 | 16:17:45 | 03 | 45 |
| 17L | OZ | 09 | 16:18:40 | 16:19:20 | 02 | 40 |
| 17L | AA | 02 | 16:20:09 | 16:20:50 | 02 | 41 |
| 18R | PO | 19 | 15:53:37 | 15:54:22 | 02 | 45 |
| 18R | ST | 19 | 15:55:30 | 15:56:22 | 01 | 52 |
| 18R | BN | 02 | 15:57:43 | 15:58:20 | 02 | 37 |
| 18R | AA | 02 | 16:03:10 | 16:04:04 | 04 | 54 |
| 18R | AA | 02 | 16:06:24 | 16:07:13 | 04 | 49 |
| 18R | AA | 09 | 16:08:20 | 16:08:57 | 04 | 37 |
| 18R | AA | 10 | 16:11:05 | 16:11:51 | 04 | 46 |
| 18R | AA | 02 | 16:13:27 | 16:14:15 | 04 | 48 |
| 18R | AA | 02 | 16:15:05 | 16:15:52 | 04 | 47 |
| 18R | AA | 02 | 16:16:32 | 16:17:17 | 04 | 45 |
| 18R | GA | 17 | 16:19:45 | 16:20:23 | 02 | 33 |
| 18R | AA | 02 | 16:19:50 | 16:20:45 | 04 | 55 |
| 18R | AA | 09 | 16:21:38 | 16:22:28 | 04 | 50 |
| 18R | AA | 02 | 16:23:33 | 16:24:18 | 04 | 45 |
| 18R | AA | 02 | 16:25:25 | 16:26:12 | 04 | 47 |
| 18R | AA | 09 | 16:27:05 | 16:27:52 | 04 | 47 |
| 18R | TN | 16 | 16:28:47 | 16:29:25 | 02 | 38 |
| 18R | FY | 19 | 16:30:05 | 16:30:48 | 02 | 43 |
| 18R | FC | 19 | 16:31:34 | 16:32:32 | 04 | 58 |
| 18R | TN | 16 | 16:41:12 | 16:41:50 | 02 | 38 |
| 18R | GA | 17 | 16:43:49 | 16:44:17 | 05 | 28 |
| 18R | UA | 02 | 16:49:40 | 16:50:44 | 04 | 64 |



TABLE A-5  
(continued)

|     |    |    |          |          |    |    |
|-----|----|----|----------|----------|----|----|
| 18R | BN | 02 | 16:51:11 | 16:52:05 | 02 | 54 |
| 18R | PO | 19 | 16:53:45 | 16:54:40 | 02 | 55 |
| 18R | FT | 20 | 16:55:30 | 16:56:20 | 02 | 50 |
| 18R | FL | 03 | 16:57:56 | 16:58:49 | 02 | 53 |
| 18R | DL | 02 | 16:59:31 | 17:00:12 | 04 | 41 |
| 18R | BN | 02 | 17:01:40 | 17:02:31 | 04 | 51 |
| 18R | NW | 02 | 17:03:32 | 17:04:26 | 04 | 54 |
| 18R | RC | 09 | 17:04:59 | 17:05:44 | 02 | 45 |
| 17L | FY | 13 | 16:22:20 | 16:23:31 | 02 | 71 |
| 17L | FY | 13 | 16:24:13 | 16:25:04 | 02 | 51 |
| 17L | AA | 02 | 16:26:40 | 16:27:11 | 02 | 31 |
| 17L | EC | 19 | 16:30:11 | 16:30:55 | 01 | 44 |
| 17L | GA | 17 | 17:04:35 | 17:05:17 | 05 | 42 |
| 17L | DL | 02 | 17:05:30 | 17:06:12 | 03 | 42 |
| 17L | OZ | 09 | 17:08:28 | 17:09:17 | 03 | 49 |
| 17L | DL | 03 | 17:10:12 | 17:10:56 | 03 | 44 |
| 17L | DL | 02 | 17:12:26 | 17:12:58 | 02 | 32 |
| 17L | PO | 07 | 17:14:21 | 17:15:25 | 02 | 64 |
| 17L | DL | 09 | 17:16:13 | 17:17:20 | 03 | 67 |
| 17L | DL | 02 | 17:17:25 | 17:18:11 | 03 | 46 |
| 17L | DL | 11 | 17:21:28 | 17:22:09 | 02 | 41 |
| 17L | AA | 06 | 17:23:42 | 17:24:32 | 03 | 50 |
| 17L | DL | 02 | 17:25:34 | 17:26:20 | 03 | 46 |
| 17L | AC | 09 | 17:28:47 | 17:29:30 | 02 | 43 |
| 17L | DL | 02 | 17:30:33 | 17:31:15 | 03 | 42 |
| 17L | AA | 02 | 17:32:23 | 17:33:06 | 03 | 43 |
| 17L | AA | 02 | 17:56:32 | 17:57:20 | 02 | 48 |
| 17L | FY | 20 | 17:58:08 | 17:58:56 | 03 | 48 |
| 17L | FY | 20 | 17:58:47 | 17:59:40 | 02 | 53 |
| 17L | FY | 13 | 18:00:00 | 18:01:12 | 02 | 72 |
| 17L | OZ | 09 | 18:02:25 | 18:03:08 | 02 | 43 |
| 17L | AA | 10 | 18:05:19 | 18:05:55 | 02 | 36 |
| 17L | AA | 02 | 18:07:41 | 18:08:39 | 03 | 58 |
| 17L | AA | 02 | 18:10:48 | 18:11:46 | 02 | 58 |
| 17L | AA | 02 | 18:12:30 | 18:13:14 | 02 | 44 |
| 17L | AA | 09 | 18:14:32 | 18:15:16 | 02 | 44 |
| 17L | AA | 09 | 18:16:06 | 18:16:56 | 03 | 50 |
| 17L | AA | 02 | 18:17:49 | 18:18:35 | 03 | 46 |
| 17L | AA | 02 | 18:18:49 | 18:19:25 | 02 | 36 |
| 17L | AA | 09 | 18:20:17 | 18:21:05 | 03 | 48 |
| 17L | EA | 09 | 18:21:30 | 18:22:40 | 03 | 70 |
| 17L | AA | 02 | 18:23:02 | 18:23:40 | 02 | 38 |
| 17L | AA | 02 | 18:24:30 | 18:25:21 | 02 | 51 |

TABLE A-5  
(concluded)

|     |    |    |          |          |    |    |
|-----|----|----|----------|----------|----|----|
| 17L | AA | 02 | 18:25:50 | 18:26:33 | 02 | 43 |
| 17L | CO | 09 | 18:27:08 | 18:27:57 | 03 | 49 |
| 17L | AA | 09 | 18:28:25 | 18:29:05 | 02 | 40 |
| 17L | DL | 02 | 18:29:42 | 18:30:28 | 03 | 46 |
| 17L | DL | 02 | 18:32:42 | 18:33:35 | 02 | 53 |
| 17L | DL | 02 | 18:34:18 | 18:34:58 | 02 | 40 |
| 17L | PO | 19 | 18:35:10 | 18:35:58 | 02 | 48 |
| 17L | DL | 02 | 18:37:46 | 18:38:40 | 02 | 54 |
| 17L | DL | 06 | 18:39:38 | 18:40:24 | 03 | 46 |
| 17L | DL | 09 | 18:41:49 | 18:42:30 | 02 | 41 |
| 17L | DL | 02 | 18:44:15 | 18:44:53 | 02 | 38 |
| 17L | PI | 03 | 18:48:36 | 18:49:22 | 02 | 46 |
| 17L | DL | 03 | 18:50:36 | 18:51:32 | 03 | 56 |
| 17L | PI | 02 | 19:33:20 | 19:34:21 | 03 | 61 |
| 17L | AA | 09 | 19:37:00 | 19:37:42 | 02 | 42 |
| 17L | AA | 09 | 19:44:14 | 19:44:53 | 03 | 39 |
| 17L | AA | 09 | 19:48:07 | 19:48:48 | 02 | 41 |
| 17L | AA | 10 | 19:50:19 | 19:50:59 | 02 | 40 |
| 17L | AA | 02 | 19:52:58 | 19:53:41 | 03 | 43 |
| 17L | FY | 13 | 19:53:45 | 19:54:33 | 02 | 48 |
| 17L | FC | 19 | 19:55:30 | 19:56:07 | 02 | 37 |
| 17L | AA | 10 | 19:57:18 | 19:58:01 | 03 | 43 |
| 17L | AA | 10 | 19:59:05 | 19:59:49 | 03 | 44 |
| 17L | AA | 02 | 20:01:22 | 20:02:03 | 03 | 41 |
| 17L | AA | 09 | 20:03:12 | 20:04:06 | 03 | 54 |
| 17L | AA | 02 | 20:05:05 | 20:05:56 | 03 | 51 |
| 17L | FY | 13 | 20:06:52 | 20:07:35 | 02 | 43 |
| 17L | AA | 02 | 20:08:18 | 20:09:04 | 03 | 46 |
| 18R | FY | 20 | 19:26:59 | 19:27:55 | 03 | 56 |
| 18R | FL | 03 | 19:36:23 | 19:37:04 | 02 | 41 |
| 18R | DL | 11 | 19:38:20 | 19:39:02 | 02 | 42 |
| 18R | AA | 10 | 19:45:19 | 19:46:06 | 04 | 47 |
| 18R | MX | 02 | 19:49:32 | 19:50:24 | 04 | 52 |
| 18R | AA | 02 | 19:53:15 | 19:53:55 | 04 | 40 |
| 18R | AA | 02 | 19:54:45 | 19:55:30 | 04 | 45 |
| 18R | AA | 02 | 19:56:35 | 19:57:10 | 04 | 35 |
| 18R | AA | 02 | 19:58:07 | 19:58:45 | 02 | 38 |
| 18R | AA | 02 | 19:59:28 | 20:00:07 | 02 | 39 |
| 18R | AA | 02 | 20:00:31 | 20:01:30 | 04 | 59 |
| 18R | GA | 16 | 20:01:49 | 20:02:37 | 04 | 48 |
| 18R | AA | 02 | 20:03:11 | 20:03:57 | 04 | 46 |
| 18R | AA | 02 | 20:04:29 | 20:05:16 | 04 | 47 |
| 18R | AA | 02 | 20:07:34 | 20:08:20 | 04 | 46 |

TABLE A-6  
ATLANTA RUNWAY OCCUPANCY TIME DATA

|           |          |          |    |    |
|-----------|----------|----------|----|----|
| 27L EA 02 | 13:51:15 | 13:51:55 | 05 | 40 |
| 27L EM 16 | 13:52:22 | 13:53:02 | 04 | 40 |
| 27L AO 21 | 13:53:20 | 13:54:00 | 04 | 40 |
| 27L EA 02 | 13:54:03 | 13:54:49 | 05 | 46 |
| 27L DL 05 | 13:58:32 | 13:59:22 | 05 | 50 |
| 27L AS 21 | 14:01:32 | 14:02:20 | 04 | 48 |
| 27L DL 09 | 14:02:58 | 14:03:45 | 04 | 47 |
| 27L DL 09 | 14:04:26 | 14:05:01 | 04 | 35 |
| 27L RC 09 | 14:08:02 | 14:08:47 | 05 | 45 |
| 27L PI 08 | 14:09:12 | 14:10:02 | 05 | 50 |
| 27L AS 13 | 14:11:47 | 14:12:32 | 04 | 45 |
| 27L AS 13 | 14:12:34 | 14:13:22 | 04 | 48 |
| 27L DL 09 | 14:13:40 | 14:14:36 | 05 | 56 |
| 27L RC 09 | 14:15:05 | 14:15:42 | 04 | 37 |
| 27L DL 02 | 14:16:08 | 14:16:51 | 04 | 43 |
| 27L CR 02 | 14:16:53 | 14:17:35 | 04 | 42 |
| 27L DL 05 | 14:18:10 | 14:18:49 | 05 | 39 |
| 27L DL 11 | 14:19:17 | 14:20:05 | 05 | 48 |
| 27L DL 03 | 14:20:59 | 14:21:45 | 05 | 46 |
| 27L DL 09 | 14:22:46 | 14:23:33 | 05 | 47 |
| 27L DL 02 | 14:23:57 | 14:24:30 | 04 | 33 |
| 27L DL 03 | 14:24:54 | 14:25:26 | 04 | 32 |
| 27L DL 02 | 14:26:02 | 14:26:44 | 05 | 42 |
| 27L DL 06 | 14:27:17 | 14:28:00 | 05 | 43 |
| 27L AS 13 | 14:28:59 | 14:29:36 | 04 | 37 |
| 27L DL 02 | 14:29:58 | 14:30:47 | 05 | 49 |
| 27L DL 02 | 14:30:50 | 14:31:35 | 05 | 45 |
| 27L DL 11 | 14:32:00 | 14:32:44 | 05 | 44 |
| 27L DL 02 | 14:33:30 | 14:34:03 | 04 | 33 |
| 27L RC 09 | 14:34:52 | 14:35:30 | 04 | 38 |
| 27L DL 03 | 14:35:58 | 14:36:43 | 05 | 45 |
| 27L AS 07 | 14:36:56 | 14:37:38 | 04 | 42 |
| 27L EM 16 | 14:37:40 | 14:38:25 | 04 | 45 |
| 27L DL 11 | 14:38:35 | 14:39:36 | 06 | 61 |
| 27L DL 05 | 14:41:02 | 14:41:50 | 04 | 38 |
| 27L DL 25 | 14:41:52 | 14:42:30 | 05 | 38 |
| 27L DL 03 | 14:43:05 | 14:43:42 | 04 | 37 |
| 27L AS 07 | 14:43:58 | 14:44:45 | 05 | 47 |
| 27L EA 02 | 14:45:18 | 14:45:59 | 05 | 41 |
| 27L AS 13 | 14:46:20 | 14:47:02 | 04 | 42 |
| 27L EA 02 | 14:47:19 | 14:47:55 | 04 | 36 |

TABLE A-6  
(continued)

|     |    |    |          |          |    |    |
|-----|----|----|----------|----------|----|----|
| 27L | DL | 02 | 14:48:22 | 14:49:06 | 05 | 44 |
| 27L | DL | 02 | 14:49:52 | 14:50:28 | 05 | 36 |
| 27L | DL | 02 | 14:50:47 | 14:51:30 | 05 | 43 |
| 27L | GA | 14 | 14:51:42 | 14:52:30 | 05 | 48 |
| 27L | DL | 02 | 14:52:45 | 14:53:30 | 05 | 45 |
| 27L | UA | 02 | 14:54:22 | 14:54:59 | 04 | 37 |
| 27L | AA | 02 | 14:55:28 | 14:56:00 | 04 | 32 |
| 27L | EA | 02 | 14:56:27 | 14:57:07 | 05 | 40 |
| 27L | AS | 13 | 14:57:23 | 14:58:00 | 04 | 37 |
| 27L | EA | 02 | 14:58:10 | 14:58:52 | 05 | 42 |
| 27L | EA | 02 | 14:59:26 | 15:00:10 | 05 | 44 |
| 27L | EA | 09 | 15:00:28 | 15:01:12 | 05 | 44 |
| 27L | EA | 02 | 15:01:24 | 15:02:01 | 05 | 37 |
| 27L | EA | 09 | 15:02:30 | 15:03:04 | 04 | 34 |
| 27L | EA | 09 | 15:03:16 | 15:03:57 | 05 | 41 |
| 27L | EA | 02 | 15:04:27 | 15:05:10 | 05 | 43 |
| 27L | EA | 05 | 15:05:32 | 15:06:06 | 04 | 34 |
| 27L | EA | 02 | 15:06:33 | 15:07:15 | 05 | 42 |
| 27L | EA | 09 | 15:07:40 | 15:08:28 | 05 | 48 |
| 27L | EA | 09 | 15:08:46 | 15:09:33 | 05 | 47 |
| 27L | EA | 09 | 15:09:38 | 15:10:25 | 05 | 47 |
| 27L | EA | 09 | 15:10:53 | 15:11:31 | 05 | 38 |
| 27L | EA | 09 | 15:11:57 | 15:12:39 | 05 | 42 |
| 27L | EA | 01 | 15:13:32 | 15:14:15 | 05 | 43 |
| 27L | EA | 05 | 15:15:16 | 15:16:10 | 05 | 54 |
| 27L | EA | 09 | 15:16:17 | 15:17:05 | 05 | 48 |
| 27L | DL | 02 | 15:18:08 | 15:18:52 | 05 | 44 |
| 27L | EA | 09 | 15:19:06 | 15:19:55 | 05 | 49 |
| 27L | EA | 09 | 15:21:08 | 15:21:51 | 05 | 43 |
| 27L | EA | 02 | 15:24:10 | 15:24:58 | 05 | 48 |
| 27L | AS | 13 | 15:25:55 | 15:26:46 | 05 | 51 |
| 27L | EA | 02 | 15:28:00 | 15:29:02 | 06 | 62 |
| 27L | PI | 08 | 15:30:01 | 15:30:44 | 04 | 43 |
| 09R | NW | 02 | 17:21:54 | 17:22:28 | 04 | 34 |
| 09R | DL | 06 | 17:23:15 | 17:24:03 | 04 | 48 |
| 09R | DL | 09 | 17:24:50 | 17:25:35 | 04 | 45 |
| 09R | DL | 02 | 17:26:09 | 17:26:49 | 04 | 40 |
| 09R | RC | 09 | 17:27:11 | 17:27:57 | 04 | 46 |
| 09R | DL | 09 | 17:28:40 | 17:29:25 | 04 | 45 |
| 09R | TN | 19 | 17:29:59 | 17:30:35 | 03 | 36 |
| 09R | DL | 02 | 17:31:00 | 17:31:37 | 04 | 37 |

TABLE A-6  
(continued)

|                                   |
|-----------------------------------|
| 09R DL 02 17:32:05 17:32:49 04 44 |
| 09R AS 07 17:34:01 17:34:54 04 53 |
| 09R CR 02 17:35:10 17:35:52 04 42 |
| 09R DL 09 17:36:14 17:36:55 04 41 |
| 09R PI 08 17:37:14 17:37:52 03 38 |
| 09R DL 02 17:38:12 17:38:51 04 39 |
| 09R DL 02 17:39:18 17:39:56 04 38 |
| 09R DL 02 17:40:32 17:41:14 04 42 |
| 09R DL 02 17:41:54 17:42:22 03 28 |
| 09R DL 09 17:42:53 17:43:37 04 44 |
| 09R DL 11 17:43:39 17:44:32 04 53 |
| 09R CR 02 17:45:09 17:45:39 03 30 |
| 09R DL 02 17:46:26 17:47:05 04 39 |
| 09R DL 05 17:47:48 17:48:35 04 47 |
| 09R DL 25 17:48:42 17:49:21 04 39 |
| 09R DL 25 17:50:10 17:51:21 06 71 |
| 09R DL 03 17:51:59 17:52:37 04 38 |
| 09R RC 09 17:52:48 17:53:47 06 59 |
| 09R DL 03 17:54:23 17:55:05 04 42 |
| 09R AS 07 17:55:40 17:56:15 03 35 |
| 09R AS 13 17:56:23 17:57:04 03 41 |
| 09R DL 02 17:57:22 17:57:59 04 37 |
| 09R LH 04 17:59:35 18:00:30 04 55 |
| 09R DL 06 18:01:21 18:02:03 04 42 |
| 09R DL 02 18:02:59 18:03:42 04 43 |
| 09R EA 09 18:03:59 18:04:40 04 41 |
| 09R AA 02 18:05:11 18:05:53 04 42 |
| 09R DL 02 18:06:18 18:06:53 04 35 |
| 09R EA 02 18:07:33 18:08:01 03 28 |
| 09R AS 13 18:08:40 18:09:20 03 40 |
| 09R EA 02 18:09:43 18:10:20 04 37 |
| 09R AA 02 18:12:30 18:13:00 03 30 |
| 09R TW 02 18:13:47 18:14:36 04 49 |
| 09R DL 03 18:14:57 18:15:25 03 28 |
| 09R EA 09 18:16:15 18:17:00 04 45 |
| 09R EA 09 18:17:18 18:17:49 03 31 |
| 09R EA 09 18:18:32 18:19:06 03 34 |
| 09R EA 09 18:19:32 18:20:11 04 39 |
| 09R EA 09 18:20:48 18:21:27 04 39 |
| 09R EA 09 18:22:17 18:22:59 04 42 |
| 09R EA 09 18:23:24 18:23:58 04 34 |

TABLE A-6  
(continued)

|     |    |    |          |          |    |    |
|-----|----|----|----------|----------|----|----|
| 09R | EA | 02 | 18:24:59 | 18:25:37 | 04 | 38 |
| 09R | BH | 03 | 18:25:59 | 18:26:40 | 04 | 41 |
| 09R | EA | 09 | 18:27:25 | 18:28:05 | 04 | 40 |
| 09R | EA | 02 | 18:28:27 | 18:29:07 | 04 | 40 |
| 09R | EA | 02 | 18:29:41 | 18:30:21 | 04 | 40 |
| 09R | EA | 09 | 18:31:34 | 18:32:12 | 04 | 38 |
| 09R | EA | 02 | 18:32:55 | 18:33:31 | 04 | 36 |
| 09R | AO | 21 | 18:34:44 | 18:35:33 | 04 | 49 |
| 09R | EA | 09 | 18:37:22 | 18:37:59 | 04 | 37 |
| 09R | AS | 13 | 18:43:21 | 18:43:52 | 03 | 31 |
| 09R | AS | 07 | 18:58:29 | 18:59:10 | 03 | 41 |
| 09R | AS | 13 | 19:01:58 | 19:02:35 | 03 | 37 |
| 09R | AS | 13 | 19:06:38 | 19:07:26 | 03 | 48 |
| 09R | DL | 11 | 19:11:13 | 19:12:13 | 06 | 60 |
| 09R | DL | 11 | 19:12:59 | 19:13:38 | 04 | 39 |
| 09R | DL | 03 | 19:14:57 | 19:15:42 | 04 | 45 |
| 09R | DL | 02 | 19:16:23 | 19:17:05 | 04 | 42 |
| 09R | AO | 16 | 19:17:56 | 19:18:37 | 03 | 41 |
| 09R | DL | 09 | 19:19:21 | 19:20:11 | 04 | 50 |
| 09R | AS | 13 | 19:20:25 | 19:21:06 | 03 | 41 |
| 09R | DL | 09 | 19:21:31 | 19:22:05 | 03 | 34 |
| 09R | DL | 02 | 19:22:52 | 19:23:32 | 04 | 40 |
| 09R | DL | 05 | 19:24:32 | 19:25:08 | 03 | 36 |
| 09R | DL | 09 | 19:25:40 | 19:26:30 | 04 | 50 |
| 09R | DL | 25 | 19:27:13 | 19:27:59 | 04 | 46 |
| 09R | DL | 11 | 19:28:40 | 19:29:20 | 04 | 40 |
| 09R | DL | 06 | 19:30:45 | 19:31:30 | 04 | 45 |
| 09R | DL | 02 | 19:32:12 | 19:32:48 | 04 | 36 |
| 09R | DL | 09 | 19:33:13 | 19:33:56 | 03 | 43 |
| 09R | EA | 05 | 19:34:09 | 19:34:35 | 03 | 26 |
| 09R | DL | 02 | 19:34:50 | 19:35:31 | 04 | 41 |
| 09R | DL | 05 | 19:36:03 | 19:36:47 | 04 | 44 |
| 09R | DL | 02 | 19:36:48 | 19:37:30 | 04 | 42 |
| 09R | DL | 09 | 19:37:40 | 19:38:12 | 03 | 32 |
| 09R | DL | 09 | 19:38:30 | 19:39:14 | 04 | 44 |
| 09R | EA | 02 | 19:39:15 | 19:39:53 | 04 | 38 |
| 09R | DL | 02 | 19:40:13 | 19:40:54 | 04 | 41 |
| 09R | EA | 02 | 19:41:07 | 19:41:51 | 04 | 44 |
| 09R | DL | 03 | 19:42:28 | 19:43:22 | 06 | 54 |
| 09R | DL | 02 | 19:43:23 | 19:44:10 | 06 | 47 |
| 09R | EA | 09 | 19:44:16 | 19:44:55 | 03 | 39 |

TABLE A-6  
(continued)

|           |          |          |    |    |
|-----------|----------|----------|----|----|
| 09R AS 21 | 19:44:59 | 19:45:29 | 03 | 30 |
| 09R EA 01 | 19:46:10 | 19:46:51 | 04 | 41 |
| 09R EA 09 | 19:48:00 | 19:48:49 | 04 | 49 |
| 09R AS 21 | 19:48:55 | 19:49:27 | 03 | 32 |
| 09R EA 02 | 19:50:09 | 19:50:53 | 04 | 44 |
| 09R DL 02 | 19:51:28 | 19:52:04 | 04 | 36 |
| 09R EA 02 | 19:52:19 | 19:53:01 | 04 | 42 |
| 09R EA 09 | 19:53:38 | 19:54:22 | 04 | 44 |
| 09R EA 09 | 19:54:49 | 19:55:32 | 04 | 43 |
| 09R EA 02 | 19:55:33 | 19:56:25 | 06 | 52 |
| 09R EA 05 | 19:57:10 | 19:57:59 | 04 | 49 |
| 09R EA 09 | 19:58:08 | 19:58:54 | 04 | 46 |
| 09R DL 02 | 19:59:09 | 19:59:52 | 04 | 43 |
| 09R EM 16 | 20:00:30 | 20:01:12 | 03 | 42 |
| 09R AS 21 | 20:01:20 | 20:01:55 | 03 | 35 |
| 09R EA 09 | 20:02:00 | 20:02:40 | 04 | 40 |
| 09R EA 05 | 20:03:09 | 20:03:58 | 04 | 49 |
| 09R EM 16 | 20:04:32 | 20:05:10 | 03 | 38 |
| 09R EA 02 | 20:06:22 | 20:07:10 | 04 | 48 |
| 09R EA 05 | 20:07:25 | 20:08:08 | 04 | 43 |
| 09R EA 09 | 20:08:31 | 20:09:20 | 04 | 49 |
| 09R EA 09 | 20:09:21 | 20:09:59 | 04 | 38 |
| 09R KL 04 | 20:10:55 | 20:11:50 | 06 | 55 |
| 09R EA 01 | 20:12:38 | 20:13:40 | 06 | 62 |
| 09R EM 16 | 20:14:24 | 20:15:04 | 03 | 40 |
| 09R EA 09 | 20:15:55 | 20:16:33 | 04 | 38 |
| 09R DL 11 | 20:17:00 | 20:17:43 | 04 | 43 |
| 09R EM 16 | 20:19:20 | 20:19:58 | 03 | 38 |
| 09R CR 02 | 20:20:28 | 20:21:09 | 04 | 41 |
| 09R AS 13 | 20:21:45 | 20:22:18 | 03 | 33 |
| 09R EM 16 | 20:22:42 | 20:23:25 | 04 | 43 |
| 09R AS 13 | 20:24:00 | 20:24:40 | 03 | 40 |
| 09R PI 03 | 20:24:52 | 20:25:26 | 03 | 34 |
| 09R DL 09 | 20:26:45 | 20:27:30 | 04 | 45 |
| 09R DL 02 | 20:31:22 | 20:32:02 | 04 | 40 |
| 09R DL 25 | 20:32:49 | 20:33:25 | 04 | 36 |
| 09R DL 03 | 20:38:50 | 20:39:29 | 04 | 39 |
| 09R DL 02 | 20:41:15 | 20:41:55 | 04 | 40 |
| 09R DL 25 | 20:41:59 | 20:42:50 | 06 | 51 |
| 09R DL 11 | 20:44:13 | 20:44:52 | 04 | 39 |
| 09R DL 06 | 20:47:58 | 20:48:42 | 04 | 44 |

TABLE A-6  
(continued)

|     |    |    |          |          |    |    |
|-----|----|----|----------|----------|----|----|
| 08L | EA | 09 | 13:26:13 | 13:26:54 | 07 | 41 |
| 08L | EA | 05 | 13:28:13 | 13:28:57 | 07 | 44 |
| 08L | GA | 17 | 13:29:45 | 13:30:20 | 05 | 35 |
| 08L | CR | 02 | 13:31:59 | 13:32:47 | 07 | 48 |
| 08L | EA | 09 | 13:34:14 | 13:34:50 | 07 | 36 |
| 08L | TS | 21 | 13:35:08 | 13:35:54 | 03 | 46 |
| 08L | EA | 02 | 13:36:16 | 13:37:07 | 07 | 51 |
| 08L | EA | 09 | 13:37:17 | 13:38:01 | 07 | 44 |
| 08L | EA | 02 | 13:38:18 | 13:38:54 | 07 | 36 |
| 08L | GA | 17 | 13:39:52 | 13:40:32 | 02 | 40 |
| 08L | EA | 09 | 13:41:09 | 13:41:48 | 07 | 39 |
| 08L | EA | 09 | 13:42:28 | 13:43:05 | 07 | 37 |
| 08L | EM | 16 | 13:44:10 | 13:45:00 | 03 | 50 |
| 08L | EA | 09 | 13:45:15 | 13:46:04 | 07 | 49 |
| 08L | EA | 09 | 13:46:48 | 13:47:28 | 07 | 40 |
| 08L | AA | 02 | 13:48:16 | 13:48:54 | 03 | 38 |
| 08L | EM | 16 | 13:51:45 | 13:52:30 | 03 | 45 |
| 08L | EA | 02 | 13:53:50 | 13:54:35 | 07 | 45 |
| 08L | GA | 16 | 13:59:20 | 14:00:05 | 02 | 45 |
| 08L | PI | 08 | 14:01:32 | 14:02:07 | 03 | 35 |
| 08L | DL | 09 | 14:03:39 | 14:04:20 | 07 | 41 |
| 08L | EA | 02 | 14:06:10 | 14:06:50 | 07 | 40 |
| 08L | ZZ | 25 | 14:09:14 | 14:09:56 | 08 | 42 |
| 08L | DL | 09 | 14:11:35 | 14:12:20 | 07 | 45 |
| 08L | DL | 06 | 14:12:52 | 14:13:30 | 07 | 38 |
| 08L | DL | 11 | 14:14:13 | 14:14:55 | 07 | 42 |
| 08L | DL | 09 | 14:16:07 | 14:16:58 | 07 | 51 |
| 08L | AS | 13 | 14:18:05 | 14:18:49 | 03 | 44 |
| 08L | RC | 09 | 14:20:11 | 14:20:49 | 03 | 38 |
| 08L | DL | 03 | 14:21:46 | 14:22:28 | 07 | 42 |
| 08L | DL | 02 | 14:23:21 | 14:24:03 | 07 | 42 |
| 08L | DL | 02 | 14:24:52 | 14:25:34 | 07 | 42 |
| 08L | RC | 09 | 14:26:32 | 14:27:13 | 07 | 41 |
| 08L | DL | 02 | 14:27:31 | 14:28:07 | 07 | 36 |
| 08L | DL | 02 | 14:29:10 | 14:29:48 | 07 | 38 |
| 08L | EA | 02 | 14:30:12 | 14:30:56 | 07 | 44 |
| 08L | DL | 11 | 14:31:16 | 14:32:17 | 08 | 61 |
| 08L | AS | 13 | 14:33:18 | 14:34:00 | 02 | 42 |
| 08L | DL | 02 | 14:34:54 | 14:35:33 | 07 | 39 |
| 08L | EA | 02 | 14:36:17 | 14:37:14 | 08 | 57 |
| 08L | DL | 02 | 14:38:13 | 14:38:55 | 07 | 42 |



TABLE A-6  
(concluded)

|           |          |          |    |    |
|-----------|----------|----------|----|----|
| 08L GA 16 | 14:40:05 | 14:40:56 | 05 | 51 |
| 08L AS 13 | 14:41:26 | 14:42:10 | 03 | 44 |
| 08L UA 02 | 14:44:12 | 14:44:45 | 03 | 33 |
| 08L EA 09 | 14:46:30 | 14:47:07 | 03 | 37 |
| 08L AA 02 | 14:48:22 | 14:48:59 | 03 | 37 |
| 08L EA 02 | 14:50:22 | 14:51:05 | 07 | 43 |
| 08L DL 02 | 14:51:30 | 14:52:15 | 07 | 45 |
| 08L EA 02 | 14:53:09 | 14:53:47 | 07 | 38 |
| 08L EA 09 | 14:55:08 | 14:55:40 | 07 | 32 |
| 08L GA 17 | 14:56:52 | 14:57:35 | 02 | 43 |
| 08L GA 16 | 14:58:59 | 14:59:45 | 05 | 46 |
| 08L EA 02 | 15:03:59 | 15:04:44 | 07 | 45 |
| 08L EA 09 | 15:06:05 | 15:06:48 | 07 | 43 |
| 08L EA 09 | 15:07:45 | 15:08:24 | 07 | 39 |
| 08L EA 09 | 15:09:39 | 15:10:22 | 07 | 43 |
| 08L EA 02 | 15:11:15 | 15:11:55 | 03 | 40 |
| 08L DL 02 | 15:13:26 | 15:14:11 | 07 | 45 |
| 08L AA 02 | 15:17:01 | 15:17:45 | 07 | 44 |
| 08L TW 02 | 15:20:09 | 15:20:43 | 03 | 34 |
| 08L DL 11 | 17:34:03 | 17:34:43 | 07 | 40 |
| 08L DL 09 | 17:35:57 | 17:36:37 | 07 | 40 |
| 08L DL 09 | 17:36:52 | 17:37:29 | 02 | 37 |
| 08L DL 02 | 17:39:55 | 17:40:35 | 07 | 40 |
| 08L AS 21 | 17:45:59 | 17:46:41 | 02 | 42 |
| 08L AS 21 | 17:49:44 | 17:50:30 | 02 | 46 |
| 08L GA 17 | 17:53:08 | 17:53:56 | 02 | 48 |
| 08L RC 09 | 17:54:22 | 17:55:11 | 07 | 49 |
| 08L DL 09 | 17:56:10 | 17:56:52 | 07 | 42 |
| 08L DL 02 | 17:57:50 | 17:58:36 | 07 | 46 |
| 08L EA 02 | 17:59:01 | 17:59:46 | 07 | 45 |
| 08L EV 02 | 18:01:07 | 18:02:00 | 08 | 53 |
| 08L EA 02 | 18:02:47 | 18:03:26 | 07 | 39 |
| 08L EM 16 | 18:04:21 | 18:05:09 | 05 | 48 |
| 08L EA 02 | 18:05:35 | 18:06:20 | 07 | 45 |

APPENDIX B  
AUTOMATED DATA COLLECTION

The ROT data collected at Los Angeles and San Francisco were recorded using a notebook-sized portable computer. Using a program written in BASIC, it was possible for a single observer to collect data for observations on up to four runways simultaneously. At the end of each day, the data were archived to cassette tape for later retrieval and statistical analysis.

B.1 Program Description

The data collection program, written in BASIC, works in the following manner:

1. The program prompts the user for the name of a file (in memory) where the collected data is to be stored.
2. The main loop of the program begins by presenting the status of each runway (runway clear/ arrival on runway) and the time. (The time display is continuously updated.)
3. An event on a runway (arrival over the threshold or aircraft exiting the runway) is signaled to the program by pressing the function key associated with that runway. This action records the current time.
4. If the event is an arrival over the threshold, the program then prompts the user for the airline (GA, for general aviation, is entered if appropriate) and the aircraft type. Following this, the program returns to the main display and is ready to record another event.
5. If the event is the exiting of an aircraft from the runway, the program prompts the user for the exit number. All information on that arrival is displayed and the user is then asked if the information is correct. If the user responds "yes," the program writes the data on that arrival to the file and returns to the main display.
6. If the user responds "no" to the prompt, the program enters an editing mode, where the user may change the:
  - a. Runway;
  - b. Airline;
  - c. Aircraft type; or
  - d. Exit number.

The program then displays the new data and once again requests that the user verify its correctness. When the user responds "yes", the program writes the data to the file and returns to the main display.

7. Finally, the program also includes a "comment key", which the user may press while the program is in the main loop. This allows the entry of a comment directly into the data file.

Although the program described above could run on any of several small computers, two hardware functions are notable:

1. The computer must have a built-in clock so that times may be recorded automatically.
2. Function keys with program-interrupt capabilities are highly desirable. These allow the program to be written in an infinite-loop form that does nothing but update the display. The loop is interrupted to record an event and resumes following that.

## B.2 Conclusions

The use of the portable computer for data collection had many benefits. The most obvious was efficiency; compared to earlier data-collection efforts, it was found that one observer could record in a shorter period of time the same amount of data as three to four observers. Also, because of the built-in clock, the times recorded were far more accurate than those recorded manually.

Another significant advantage was that the data were recorded in machine-readable format. This meant that the data could be transferred to a more powerful computer for statistical analysis in minutes rather than days. This electronic transfer of data also removed the need for manually entering each data record into the more powerful computer, thus eliminating a step where errors could be introduced.

Finally, the recording of data in the portable computer allowed the observer to instantly perform a preliminary statistical analysis of the data. This was accomplished using a simple statistical program retained in memory.

The computer used for this study contained 24 kilobytes of random access memory for retaining programs and data. This is the minimum amount of memory necessary to collect one day of data. It would be desirable to use a computer which includes a built-in disk drive, which is a faster and more reliable means

of archiving data than an external cassette tape recorder. Also, the retention of data in this form would facilitate the transfer of the data to a more sophisticated machine.

It should also be noted that the data collection program could be easily modified to obtain information on departures, inter-arrival separations, and so on. It represents an efficient means of collecting information vital to the airport capacity-increasing effort.

APPENDIX C  
LIST OF ACRONYMS

|     |                                      |
|-----|--------------------------------------|
| FAA | Federal Aviation Administration      |
| IMC | Instrument Meteorological Conditions |
| mph | Statute Miles Per Hour               |
| nmi | Nautical Miles                       |
| ROT | Runway Occupancy Time                |
| VMC | Visual Meteorological Conditions     |

APPENDIX D  
REFERENCES

1. A. L. Haines, R. M. Harris, and A. N. Sinha, "Operational Techniques for Increasing Airport Capacity", The MITRE Corporation, Metrek Division, MP-82W24, October 1982.
2. W. J. Swedish, "Evaluation of the Potential for Reduced Longitudinal Spacing on Final Approach", The MITRE Corporation, Metrek Division, MTR-79W280, (FAA-EM-79-7), August 1979.
3. W. E. Weiss and Dr. J. N. Barrer, "Analysis of Runway Occupancy Time and Separation Data Collected at La Guardia, Boston, and Newark Airports", The MITRE Corporation, Metrek Division, MTR-84W228, (FAA-DL5-84-2), December 1984.